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ERRATA Volume 116

Page	Line	
19096	16	"on a map" should read "of an event"
	17	"where" should read "or"
	18	"observations in a given magnitude" should read "magnitudes of a given measure".
	30	"study" should read "set"
19097	19	"should read "standard errors which were to indicate ..."
	26	"study" should read "set"
	29	"their" should read "there"
19100	24	"being" should read "mean"
19101	4	The word "error" should be inserted following the word "standard"
	19	"axis" should read "axes"
19102	23	"of" should read "on"
19106	3	should read "of cost with output"
	18	should read following the period. "In railway costing, this concept of one hundred per"
	19	"cent variability means a situation where"
	28	"costant" should read "constant"
19108	6	should read "you a good fit but would not give an explanation of the length of the arms".
	15	should read "the divisions are of different sizes ..."
19109	8	the first two words on the line are "individual coefficients".
	9	insert the word "dependent" before "variable".
19112	21	delete "you are contributing"
	24	delete "little"

ERRATA (continued) Volume 116

Page	Line	
19113	9	"plucked" should read "extracted"
	26	insert "technique" after "ultimate"
19114	9	Variations (spelling)
19173	8	"Pooles" should read Poole's"
	15	"on" should read "which"
	16	should read "I prepared. In the interest ..."
19181	6	"7.2%" should be "18.27%"
		lines 9-26 inclusive should be deleted here-and inserted on page 19182 following line 6.
19183	9	"our" should read "a"
	9	"equation" should read "account"
19186	22	insert "take" before "the sloping line"
	23	"for" should read "by" "car" should read "gross"
	30	delete "but not to". Put a period after "equation"
19187	2	delete line entirely.
	3	line should read "The CPR compute the constant ..."
	4	insert "and the variable cost;" after "statement"
19193	9	"estimates" (spelling)
19196	16	should read "have tried to substitute allocations of the expense account"
	25	"concession" should read "confession"
19197	29	"should" should read "could"
19284	16	"White Laird" should read "Dwight Ladd"
19291	1	insert "classifications" before "time"
19296	18	"Tracks" should read "Taxes"
19300	18	"respectfully" should read "respectively"

I N D E X

NO EXHIBITS IN THIS VOLUME

ROYAL COMMISSION ON TRANSPORTATION

Proceedings of hearings held
in the Convention Hall,
Chateau Laurier, Ottawa, Ontario,
on the 10th day of November, 1960.

COMMISSION

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Ottawa, Ontario,
Thursday,
November 10, 1960.

--- On commencing at 10:00 a.m.

THE CHAIRMAN: Order, please.

MR. COOPER: I understand, Mr. Chairman, that my friends Mr. Mauro and Mr. Frawley propose to call the evidence in chief of Dr. Borts and Mr. Banks, and that that is expected to take the better part of today, and Mr. Sinclair who is ready to proceed with the cross-examination of Dr. Ulmer will proceed with that when that evidence in chief is in, and it is hoped perhaps he may be able to start today and go on tomorrow.

THE CHAIRMAN: Well, gentlemen, that is fine.

I may say that tomorrow -- we all know the day, the 11th of November -- and we all want to honour the dead tomorrow, so we will adjourn at 11:45 to reconvene at 11 o'clock for two minutes silence and go on.

MR. MAURO: Q. Thank you, Mr. Chairman.

Dr. Borts, at adjournment yesterday we had qualified you and associated you with this brief called a memorandum "The Cost to the Canadian Pacific Railway of Moving Grain to Export Positions in western Canada," plus an addendum to that brief.

Dr. Borts, I thought that before we actually went into the submission that we should try and define

some of the terms that this Commission has heard since last December and for some of us they are both difficult of comprehension and used in different contexts, and I thought at least for the submission of the provinces of Manitoba and Alberta, which you are associated with, we would define our terms, particularly such terms as population groups; variable; variability; linear and multiple regression; cross-section data; R factors; and T values -- to mention a few of them. So, Dr. Borts, if we could start, perhaps you would define population groups. We have heard this expression used in statistics.

A. Yes. As this expression is used in statistics, a population group refers to an entire set of possible outcomes of a specific kind on a map, where you can think of it as the entire set of possible observations in a given magnitude.

If I might, for example, make reference to the weather. If you think of the population of observations which the meteorologists refer to, they are thinking of all the possible outcomes of weather which they are likely to observe during the year. So that, to the meteorologists who use statistical methods the population consists of all possible outcomes; all possible magnitudes of rainfall which they are likely to observe, or all possible magnitudes of snowfall or wind velocity.

The population as it is used is simply the study of all possible occurrences which you are

likely to observe.

Q. During a specific period?

A. Possibly during a specific period; possibly in a specific place, yes.

Q. Now, you have given us the example of the meteorologists if you were using a statistical approach in considerations of weather. Can you apply it to the cost of grain?

A. Yes. Now, in the cost material which the Commission has heard and in the cost material that it is going to hear, the concept of sampling has been used and the estimates which have been presented are referred to as probability estimates of the way in which a specific population behaves.

You will recall, for example, in the material which both railway companies presented in their regression relations that each of those had certain standards of error which was to indicate that this was an estimate of a certain characteristic of the population rather than the exact word as to the way in which the population behaved. Now, I have not answered your question yet.

Q. No.

A. The population in the case of railway costing consists of the entire possible study of outcomes of the way in which the railway does its business. And you might conceive, for example, of their being variations in weather, say, snowfall on the track, which are going to affect the speed at

which the trains run; which affect the way in which the trains can be hauled. You can think of people who work on the railway -- they may have a headache in the morning so that they work a little slower, or a little faster. You can also conceive of the fact that there are always errors in planning which any business firm might be subject to. So that there is an entire set of possible observations of cost which might be made for any particular level and position of traffic.

It is in this sense that we think of the concept of population as it is applied to railway costing, and it is from this definition of population that we try to infer something from the observations on railway costs which we have.

Q. Would it be fair, then, in the context of our study here before this Commission to say that where the term population is used it is simply all of the possibilities that might occur in the given study?

A. That is correct.

Q. All of the possibilities.

Now, what about the term variable. What does the statistician or the econometrician mean?

A. The term variable simply means an entity or an object that can take on certain numerical values. Again, if I may start off with an example in meteorology, rainfall is a variable. You might have a month with very little rainfall, or a month with very heavy rainfall.

In biology or physiology, the height or weight of people are variables because this is a magnitude which takes on different numerical values from one end to another.

Getting down to railway costing, we treat the cost of roadway maintenance as a variable, in the sense that this magnitude has been observed to take on a number of different possible values at different places and at different points of time.

Q. We have heard dependent and independent attached to the word variable.

A. Well, when the terms dependent and independent are attached to the word variable, the speaker has in mind some type of relationship between the dependent and the independent variable, such that a change in the independent variable is going to produce some corresponding change in the dependent variable

Q. Can you give an example that is closer to us?

A. We will start with a simple one. My weight is dependent on the amount of food I eat. And in the context of explaining my weight, you would refer to the amounts, the calorie type, etc., the amount of exercise I do, as independent variables which determine my weight.

In the case of railway costing, we refer in an example in the case of track maintenance, the wear and tear which is imposed on the track as an

independent variable determining the amount of maintenance which is necessary to restore the track to its initial quality.

Q. So the amount of track maintenance is the dependent, the amount of use is the independent which determines the track maintenance?

A. Yes, that is correct.

Q. How about this phrase"standard of error"in the statistical work?

A. If we get back to the concept of a variable again, which is an entity that can take on different numerical magnitudes, the standard of error is simply a mathematical concept which has been defined by statisticians to give you a measure of the degree of variability which exists. It is simply an arithmetical measure of variability where this measure is taken around the average for the groups that you are speaking of.

Q. I take it, then, that it is in effect a bench mark or a test?

A. Not a test, but it is a measure of the spread or dispersion of a group of observations about their being.

Q. You would establish, then, in any given study or phase of a study a mean; is that correct, Dr. Borts?

A. Well, if you have a sample, why, you automatically have a mean, but it is an average ---

Q. This is the important prerequisite on

this concept of standard of error?

A. Yes.

Q. You have a mean, and then the standard is a variation on one or other side of the mean, the swing is on one side or other of the mean?

A. Yes, that is correct.

Q. We will get into this idea of linear or multiple regression, Dr. Borts, which we have heard so much about.

Now, as I understand it, and I am going to put it down on the blackboard as a layman, and then you can correct it. I understand that we can have a simple linear regression, and then we have this idea of a multiple regression, and that these will appear in a mathematical illustration as what they call a scatter diagram?

A. Yes.

Q. And that we have two axis -- a vertical axis and a horizontal axis -- and for the sake of this illustration, assuming that this is the portion of the graph that pertains to dollars of maintenance ---

MR. SINCLAIR: This is going to be some record.

MR. MAURO: Well, just wait.

Q. The line on the graph vertical depicts dollars of maintenance; the horizontal line on the graph miles of track.

As I understand it, Dr. Borts, under the method of simple linear regression, various railways

make observations from their experience as to the dollars of maintenance and their variability with miles of track; is that correct?

A. Yes, you have a scatter diagram.

Q. And we have established the scatter diagram from their experience and observations, and you might have the Pennsylvania Railway up in a situation such as this (indicates) and the New York Central, Union Pacific, and any number of them would be plotted on this graph?

A. Yes.

Q. Then, you would describe a line which would be worked out on a least squares method on the graph?

A. Yes.

Q. And this would be a simple linear regression?

A. That is correct. The line which would be fitted to that scatter of points, the least squares method would be a simple linear regression. In this case, it would be spoken of as the regression of maintenance of miles of track, that is correct.

Q. Or the degree to which ---

A. No, no, that would be the way you describe the line, and it would be a simple linear regression.

Q. Right. And, then, if this line were projected through to the vertical axis, am I correct in saying that this portion is what is referred to as

the constant cost, and this portion to the variable?

A. Yes. The way in which this is used in railway costing is that the line is extended back to the vertical axis. In most cases, when it comes back, there is a positive constant which is referred to as a constant or a threshhold cost, and anything exceeding that threshhold is referred to as a directly variable cost.

Q. Moving into multiple regression, as I understand it, it introduces other forms of variables?

A. Other independent variables.

Q. Other independent variables. And you might have, assuming that we are now going to incorporate the variable of gross ton miles in this maintenance miles of track situation, you would have -- this would be at one million G.T.M., and then, perhaps, at two million G.T.M. and three million, and so on?

A. That is what you would have. Each of these would be parallel to each other. Parallel lines, shifting by the amount of the other independent variable in your example.

Q. So that while the simple linear regression had confined itself to depicting the variability or the action of cost, the effect on cost viz a viz miles of track, multiple regression then introduces another independent factor in this illustration?

A. One or more, yes.

Q. In this illustration, I introduced gross ton miles?

A. That is correct.

COMMISSIONER MANN: Mr. Chairman, I think it would be appropriate to say at this moment that this Royal Commission has already done something useful. It has, judging by the blackboard technique of Mr. Mauro, I think, given some spare capacity to the economic staff of the University of Manitoba.

MR. SINCLAIR: If I may say so, sir, not until he draws that diagram with three, four and five planes on it.

MR. MAURO: You should see some that we rejected, Mr. Sinclair.

MR. SINCLAIR: We will let Dr. Borts do that.

MR. MAURO: Q. Now, Dr. Borts, I wonder whether we could move on to a discussion of the phrase "cross-section data, depth concept"?

A. Yes, the cross-section data -- the term refers to the sample of observations which is used and has been used very frequently in railway costing work and a cross-section sample consists of observations on a group of operating units all within the same point in time. The operating units might be divisions or districts of the same railway system, as in the case of these exhibits, or it might be observations on different railway companies themselves.

The idea is that you are observing at a point in time; that is, the operations within a year

or two or three years of cost and output variables, looking at a group of different operating units simultaneously.

Q. Let us take the grain study -- that was a three year period?

A. Yes.

Q. So, that is the time factor?

A. That is correct.

Q. And let us look at switching. How does that cross-section data apply?

A. Well, let us take the track maintenance. The railway company and we make use of a cross-section sample of observations on the divisions of the railway. The sampling that we used was a cross-section sample of observations on the 27 operating divisions of the railway company. The Canadian Pacific Railway's procedure was somewhat different. In theirs, I believe they used a cross-section sample of observations of 31 divisions -- 27 operating line haul divisions and four terminal divisions. But in either case, you would refer to this as a cross-section sample.

Q. Now, what about this phrase "variability of output with cost"?

A. Yes, that term is used in railway costing with specific reference to the type of straight line relationship which you have drawn here. If I may -- do you have any pride of authorship or could I change this?

Q. I was very proud of it but you can change it.

MR. CUMMING: We are all entranced.

THE WITNESS: If I could change this to read gross ton miles and just look at one of them. In railway costing the concept of variability with cost concerns itself with the extent to which a change in output, a one per cent change in output is accompanied by a greater than or less than one per cent change in cost. In railway costing this costing of one per cent variability, when they refer to a situation where a one per cent change in output is accompanied by an equal per cent change in cost.

MR. MAURO: Q. I just want that clear because we have heard in this submission that it is completely variable?

A. Yes, that is what they mean. I might say when you have complete variability you are talking about a relationship which comes from the origin here, there is no costant element at all. If you have complete variability in this sense as it is used you have no constant element when you extend the straight line

back. On the other hand, what is more frequently observed through statistical operations is when you extend the straight line back you have a positive constant and under those circumstances you do not have complete variability, you have less than 100% variability as evidenced by the fact that this portion of the cost does not vary.

Q. What about this R factor?

A. The correlation coefficient?

Q. Yes.

A. The correlation coefficient in regression work is a measure of the extent to which the regression line, speaking of simple regression, a measure of the extent to which the regression line fits the scatter of points through which it passes. In other words, as you previously drew this we have a scatter of points around here and the correlation coefficient simply measures the extent to which all of these points lie off the line. The closer the points fit the line the greater will be the correlation coefficient and the correlation coefficient can give no higher unity. If all the p oints are on the line you have a correlation coefficient of one.

Q. We have seen these factors introduced into the evidence and according to what you have told us, an R factor could never be greater than one?

A. That is right.

Q. If it was one it would be on the line. What the statistician is trying to achieve is the closest relationship to one?

A. Well, that is a difficult question. What

the statistician is trying to do is get the most relevant information out of the data which he has. To give a very good example of where high correlation does not count: you can accurately compare the length of a person's left arm with their right arm and that would give you a good fit but would not give the length of the arms.

I suggest in any costing work where you are dealing with a problem of assigning cost to output units it is quite true you have to look for high correlations as an indicator of how closely you are fitting the data. But, at the same time, you have to make sure that your correlations are not irrelevant in some sense because of the fact in this particular case where you are dealing with different divisions of the railway and the divisions of different sides, you, in a sense have a situation where the big elephants have big feet and the little elephants have little feet.

Sometimes a correlation can come out very high without being very meaningful.

Q. You are applying it to large divisions of the railway and small divisions?

A. That is right.

Q. If you had an R factor that was .7534 and an R factor that was .5734, which would have more meaning?

A. The larger the R factor the better the fit. I would caution against using goodness of fit as the only criterion in using this technique for costing.

Q. You have to apply the relevant data in that situation?

A. That is right.

Q. What about T values?

A. Yes, the T values refer to a test which is employed mainly in multiple regression. Though it could be employed here it does not have to be because we also have the R as a measure of goodness of fit but in the R there is a problem of testing the various individuals one by one taken by this to see the extent to which they have an influence on the variable. The so-called T test which I have described in my memorandum and which is alluded to in the testimony is a test of the extent to which the regression coefficient, that is the slope relationships, can be regarded as something other than zero, because if it is zero-- I might show you -- if the slope relation is simply zero it is clear that the independent variable has no influence on the dependent variable statistically speaking. That is, in other words, you might as well use a guess out of thin air as to what this influence is as to try to derive the information from any statistical technique. The T test is a test of the extent to which this slope is either positive, indicating there is an influence or the extent to which it may be regarded as zero in which case there is no statistical influence and you might as well substitute an informed guess for all the good that a statistical operation will do you.

Now, I have not given you a description of the test but that is what the test does.

Q. Well, the import, the T value has to ascertain or judge the validity statistically of the conclusion?

A. Of the value of the coefficient, yes.

MR. SINCLAIR: Will you do F now so we can have them together?

MR. MAURO: Q. Do you want to say anything on regression co-efficient?

A. Regression coefficient is the measure of the slope, it is the extent to which, in this example, the cost will rise if you have a unit change in one of the independent variables. In this case the independent variable is gross ton miles and if you have a unit change on gross ton miles the regression coefficient shows you the extent to which the cost rises.

Q. And this will become the multiplier?

A. You would use a regression coefficient and multiply it by the number of service units on gross ton miles in allocating costs to gross ton miles, that is right.

Q. So, that is its application in the grain cost study, you determine the regression coefficient which is the degree of increase in cost by increase of output unit?

A. That is right.

Q. And then use it to multiply, to find the cost of that particular sample or factor in that movement of grain?

A. Yes.

Q. Now, I would ask you, Mr. Chairman, that the document, the memorandum referred to be taken into the record. This has 43 pages and I will just refer

to various sections of it with the permission of the Commission.

MR. CUMMING: When you say forty-three pages that is just the memorandum, but you do want the addendum to go in?

MR. MAURO: Yes, the addendum too.

Q. Would you care to refer to the addendum, Dr. Borts, and the corrections that it makes and the reasons for them?

A. Yes, the specific content of the addendum refers to a correction which we indicated we would make but did not make in the memorandum when it was first prepared. In order to indicate why a correction was necessary I have to go back and indicate what ---

Q. Perhaps if you spoke a little louder.

A. Yes. In order to indicate why the addendum was necessary I have to go back to indicate the nature of the corrections which we felt were necessary in the Canadian Pacific attribution of track maintenance cost to service units and to size units. I felt in this case that the relationship which the railway derived which purported to describe for the railway system as a whole the reaction of track maintenance to variations in output and size units, I felt this relationship ignored a very important aspect of the railway's operation, namely the geographic nature of the terrain and the climatic conditions under which the railway operated. It seemed to me that there were very strong differences from one division to the next in the extent

to which roadway maintenance would be affected by this geographical problem. I might say that this approach was suggested by an examination of what the Canadian National exhibit presented where in their own track maintenance equation they attempted to make some allowance for this by introducing the miles of tunnels as an additional independent explanatory factor in a multiple regression equation. Now, it turned out on examining the data of the C.P.R. that we could not get directly a measure of this geographic problem. We had some information on track curvature for the western divisions of the company and we attempted to use this statistically but to no avail. What I, therefore, decided to do was to use this investment account, actually it is two accounts together, I believe they are 5 and 6 in the railway's accounting scheme but use this investment account in tunnels, bridges and culverts as a proxy indicator of the geographic nature of the railway's operations. It must be borne in mind that when you do this you are contributing, you are using the variable in order to attribute to geography a certain amount of the railway track maintenance expenditure. It does not in any little sense mean that what we are doing is simply investigating the railway's maintenance of tunnels, bridges and culverts. If we wanted that information we could look it up in their accounts. What we are trying to do is to attach to the measure of geography what we feel was the appropriate share of the track maintenance

expenditure.

Now, the procedure which I followed therefore was to construct other additional regression equations, that is additional to those which the railway have presented in its exhibit or additional to those which the railway has experimented with and so kindly let us see in their own work sheets.

We derived an equation which I felt very satisfactorily plucked the statistical information out of the data. In other words, we got as far as we thought we could get on the basis of multiple regression alone. The equation I am referring to is on the bottom of my exhibit No. 202A.

Q. That is at page ---?

A. Page 4. The equation labelled 202 was the original equation which underlies the railway's own cost allocation.

Q. 202 is the C.P.R. equation?

A. Yes.

Q. 202A is your first equation?

A. Yes, the first equation which we used. Now, we looked at that for a long time and we decided it was not quite as far as knowledge could go, it was as far as knowledge could go on the basis of multiple regression but we do not believe that multiple regression is the ultimate here and if it can be supplemented with an engineering estimate why we are prepared to make use of engineering estimates. One of the reasons for that was that when we costed out the track maintenance associated with miles of track, the so-called size

relation track maintenance costs which is referred to in the C.P.R. exhibit, we discovered that figure came to $469 per mile of track.

Q. Where did that come in?

A. In the middle of page 6, paragraph 2.

Q. $468.97?

A. Yes, and the statisticians of the company have a work sheet indicating how it is derived from the equation. What we decided to do then was to -- we felt this estimate might be lower than the threshold level of track maintenance which we felt to be the appropriate concept for a solely related branch line. By a threshold concept of track maintenance I mean simply the dollars of maintenance on a mile of track where it is not used at all. We decided to use an engineering estimate of the threshold level of track maintenance. By "threshold level of the track maintenance" I mean the amount which would be spent in maintaining a mile of track if there were no traffic on it at all, because we felt that this would be the appropriate concept to use in costing out the amount of track maintenance money attributable to the solely, what has been referred to in this study, as the solely related branch lines.

THE CHAIRMAN: I understand you were searching for appropriate gauges.

THE WITNESS: Gauges?

THE CHAIRMAN: Yes, to gauge costs?

THE WITNESS: Yes.

MR. MAURO: Q. That is a dangerous word to

use on the railways.

A. What we did therefore, and this is more fully described in memorandum No. 2 and only alluded to in the addendum to memorandum No. 1, what we did was to prepare an engineering estimate of the threshold level of track maintenance cost. It was then necessary to re-do this, re-compute the coefficient on our regression equation because we now feel we have accounted for track maintenance cost which the railway experiences.

[illegible]

Accordingly, we subtracted for each division the amount of cost which we felt was the threshhold level, and we consequently found ourselves left with a small remainder of cost which had to be explained by multiple regression techniques.

Q. So we get this in some understandable specific form, you would look at an area or track mileage and you would say that the total maintenance cost of that mileage was, we will say, $1,000 per mile, and then you would subtract from the $1,000 an amount which you had determined to be a constant or threshhold cost -- not constant; a threshhold cost.

A. A threshhold cost, yes.

Q. A cost that would have been there if they had carried one pound of freight?

A. Yes, or none at all.

Q. Would you then have left, say that figure was $200, you would then have a figure of $800?

A. I might add, the figure which we regarded as our threshhold cost came to $742.52 per mile of track.

Q. And you subtracted that ---

A. That was subtracted from the maintenance expenditure for the division in our sample of observations, and it was a remainder which we felt required to explain in our multiple regression work.

I should point out, for this reason the R

factor which you will find on page 2 of the addendum, which is .6942 is not properly comparable with the R factors which were referred to earlier on page 4, because they refer to a smaller total body of variation, since we have already adjusted the track maintenance in the manner I have described.

Q. The corrections or changes should be inserted at page 6?

A. That is correct.

Q. Turning to page 6, this 202B, we are correcting with 202C ---

A. Oh, no; this does not change anything.

Q. This is an addition?

A. This is an addition and simply refers to the equation which is finally used in preparing our own estimates of cost as they are shown at the end of exhibit 2.

Q. And in the new equation the constant which in 202B on page 6 had been $1,020,290, in the new equation is $1,390,000?

A. That is correct, but I have to make a point about that which will take some time, but I would like to get it on the record, if I may. I think it will help in understanding what we did.

This is, again, referred to more completely in memorandum No. 2, but since you brought up the constant I think I should make it clear this constant was not entered as it stands in the derivation of constant costs because we derived in addition a cost

co-efficient for yard and train switching miles which again on a constructive basis -- and I will not call it an engineering basis, but on a constructive basis -- is subtracted from this constant.

In order to make it clear, this constant does not go into the constant cost figure.

Q. Dr. Borts, would you read in paragraphs 1, 2 and 3 of your brief?

A. Yes.

Q. Of the main memorandum?

A. 1. The governments of Manitoba and Alberta are submitting estimates of the cost to the Canadian Pacific Railway of handling Crow's Nest grain. The statistical methods underlying these estimates are presented in two studies. The study to be described here consists of an evaluation and correction of certain of the regression models presented by the Canadian Pacific Railway. In addition, estimates are presented pertaining to the pertinent economies of multiple car cuts in classification switching. The second study contains an evaluation and correction of (a) the work units applicable to grain and (b) the allocation of certain expense accounts to constant and variable costs. The second study also synthesizes the corrected work units with the corrected regression equations presented here to provide a revised estimate of grain costs.

The third study which has already been presented pertains to "the permissive earnings upon

railway investment".

2. The most important criticism to be levied against the CPR regression study is the failure of the estimated equations to depict output and cost variation among regions of homogeneous operating characteristics. With but few exceptions the CPR regression equations are estimated from a cross-section sample of observations on the railway's 27 line haul operating divisions. The 28th division is an electrified line and has been excluded by all parties from the sample. The four terminal divisions were also excluded in all but one case. In a few cases the regression equations were not derived from observations on the 27 divisions; instead the ten districts were used as the sample. Generally the reason for using districts instead of divisions depends on the detail in which certain expense categories are maintained. However, in one case, pointed out below, 10 districts were used to estimate an equation, even though observations on the 27 divisions are available.

In order that a cost-output regression from cross-section data truly depict the variability of cost with output, certain minimal conditions must be satisfied by the data. The most important is that operating characteristics vary as little as possible from one observation to the next. This does not mean that output and expense units should be of the same magnitude in each observation, but rather that the underlying forces conditioning the response of cost to output be

the same among observations. The failure of the observations to satisfy this condition can produce serious bias in the estimated variability of cost. For example, suppose that in the western divisions of the railway more gross ton miles are hauled than in the eastern divisions, and that due to conditions of geography, expenses per ton-mile are higher in the west. The effect of combining eastern and western observations is then to overstate the degree of variability with cost present in either region, for the observations with higher unit cost are at the upper level of the output scale.

Perhaps I should illustrate that on the board.

MR. SINCLAIR: This is a hypothesis that you are making?

THE WITNESS: This is a hypothetical example, that is correct, to illustrate the homogeneity which, if it existed, would introduce bias.

Your western regions are here and your eastern regions are here; in other words, within each region there is no -- hypothetically, now -- there is no observed variability of cost with output and yet, because of the way in which the two observations lie in this diagram, there is a line which can be drawn through it, and as the line is a slope over the zero the variability of output with cost is over-stated. This is the hypothetical example which I referred to.

MR. MAURO: Q. The point there being that

while the two regions, east and west, are homogeneous within their own region, in your example, it would be an example of bias if you attempted to draw a line joining the two?

A. Yes, that is correct.

COMMISSIONER PLATT: If I may just interrupt there for a moment, Mr. Mauro. Is the effect that you are getting here that each group or region in effect, becomes one dot rather than a group of dots?

THE WITNESS: This is the effect, yes. This is not what we are striving for.

COMMISSIONER PLATT: But what you have, in effect, is really only two observations.

THE WITNESS: From this point of view, that would be correct.

COMMISSIONER PLATT: And, therefore, any such relationship would be spurious?

THE WITNESS: That is true.

COMMISSIONER PLATT: And any time you work with two observations this sort of thing is something you have to watch for very carefully?

THE WITNESS: Correct.

Certain of the CPR regression models contain an attempt to account for this geographic difference. This was done by inserting independent variables which reflect such geographic differences. For example, in the track maintenance equation, miles of track is used as an independent variable. The purpose of introducing this variable was to explain variation in the cost which

is unrelated to variation in output. The use of track mileage in this equation then permitted the direct allocation of track maintenance to a certain portion of solely related branch line facilities. Alternative specifications of this model -- that is, alternative specifications which I have carried out -- reveal that the track maintenance cost attributed to track mileage is actually explained by the nature of the terrain covered by the railway. In an equation presented below, this cost is shown to be associated with the investment in tunnels, bridges and culverts. The track maintenance cost which is statistically associated with track mileage is actually far less than the CPR claims, when correct allowance is made for geography.

The influence of geography on cost gives rise to differing degrees of association between cost and output in the regions of the railway. Again splitting the railway into east and west, we see that the correlation co-efficient between track maintenance and gross ton miles is .94 in the east but only .56 in the west.

MR. MAURO: Q. That you explained to us when you were defining the correlation co-efficient?

A. Yes.

Q. Is that degree which cost increases with an increase in output?

A. That was not --- let me correct you there, if I may?

Q. Yes.

A. Correlation co-efficient is the measure of goodness of fit of the line to the scattered points, and this says that there is a much better goodness of fit in the east than in the west, and if you square these correlations you can see that in the west you only reduce the variability by about 30% when you fit a line to it, whereas in the east you reduce it by over 80%.

Similarly, the correlation between track maintenance and switching miles is .63 in the east and .35 in the west. By combining the two regions and ignoring the regional differences in variability, the CPR statisticians have imputed to the western region a degree of association and a measure of variability between cost and output which is essentially a reflection of their close relation in the east.

3. The statistical models to be presented in this study are corrections of the CPR models in the sense that they make allowance for geographic differences among the observations. These corrections take a number of possible forms as will be seen below:

(a) The correction may be the specification of an alternative independent variable in a regression equation.

(b) It may take the form of separate cost-output relationships for the eastern and western divisions of the railway.

(c) It may take the form of deletion of

certain observations from the sample, where there is clear evidence of lack of homogeneity in the operating characteristics of the division.

Q. Then follows the material we have already referred to -- exhibits 202 which is the CPR equation, and your equations 202A,B, and C?

A. That is right.

--- A short recess ---

THE CHAIRMAN: Order, please.

THE WITNESS: The following is a presentation of the CPR regression equations which are superseded by the results of our statistical study.

4. Account No. 202, etc: - Track Maintenance and Depreciation.

The CPR regression model as revised for exhibit 132 showed the following where Track Maintenance and Depreciation is the independent variable.

202

Independent Variables	Value of Coefficients	Standard Error	Value of T
1. Constant	$1,208,385	$521,668	2.32
2. Miles of Track	1,136.8111	186.18347	6.11
3. GTM (1 frt. ≠ 2 pass.)	0.16475	0.03117	5.29
4. Yd.and Train Switching Miles	0.39053	0.17850	2.19

The value of R^2 with 27 observations was 0.827.

In our corrected model, we have made use of another variable in addition to track mileage to correct for geographic heterogeneity. This is the Investment in Tunnels, Bridges, and Culverts (the sum of Road Property Investment accounts No. 5 and 6). The resulting equation for the system is:

202A

Variables	Value of Coefficients	Standard Error	Value of T
1. Constant	$ 652,060	$937,185	0.70
2. Investment in Tunnels, Bridges and Culverts	0.10730	0.03230	3.32
3. GTM (1 frt. ≠ 2 pass.)	0.14378	0.03424	4.20
4. Yard and Train Switching Miles	0.9640	0.3025	3.19
5. Miles of Track per 100 dollars of Investment in Tunnels, Bridges & Culverts	0.7171	0.1698	4.22

The value of R^2 with 27 observations was 0.7901.

While it is true that the value of R^2 in the substituted equation is slightly lower than that in the equation presented by CPR, this may not be a reliable indication of the validity of either equation. Using R^2 as a descriptive measure of goodness of fit, it is clear that both equations fit about equally well. In conversations with the statisticians of the CPR and in examining the alternate regression models which they fitted to the data but did not use, it became clear that the magnitude of R^2 was frequently neither the sole nor most important criterion they used for choosing one regression specification over another. This is a defensible point of view considering that the purpose of fitting the regression is to get a relation between relevant magnitudes which will permit a proper cost allocation, and proper predictions of cost variability.

MR. MAURO: Q. Dr. Borts, could you expand this last statement:

"This is a defensible point of view considering that the purpose of fitting the regression is to get a relation between relevant magnitudes which will permit a proper cost allocation, and proper predictions of cost variability."

A. Yes. What I was referring to there was already mentioned previously, where we discussed the question of whether a statistician is looking only for a very high correlation or whether there are other goals which he has in mind, such as the relevance of the cost relationship which he is trying to fit. What I am suggesting is that a relevant relationship as suggested to us by the way in which a company operates may not always give us the highest R square. In fact, in the two equations which I was contrasting on page 4 there was a slightly lower R square in 202A than in 202. That was the import of those comments.

Q. Would you go on, Dr. Borts, please?

A. In addition it is clear from an examination of the values of T in the new equation that evaluation of the coefficients within a probability framework would indicate that all but the constant term were significantly different from zero at the 5 per cent probability level. The equation we have fitted indicates that a substantial portion of track maintenance expense is explained by the geographical nature of CPR operations. This influence is captured

in our equation by the variable which measures Investment in Tunnels, Bridges and Culverts. This indicates that track maintenance depends to a large extent on gradient and curvature and on the extent to which passage over the division requires elaborate supporting structures or excavations.

Further, it should be noted that there is no significant correlation between this investment account on the one hand and any of the following variables taken individually: Gross ton-miles, yard and train switching miles, or miles of track. As a consequence we feel justified in regarding the Investment in Tunnels, Bridges and Culverts as unas-sociated with any of the variables which influence the cost of hauling grain. Therefore the track maintenance costs associated with this investment account can be regarded as unassociated with any of the variables influencing the cost of hauling grain.

The last variable in the new equation is miles of track per dollar of investment in Tunnels, Bridges and Culverts. When this variable is adjusted to reflect the value of investment in each division, it becomes $468.97 per mile of track. This magnitude appears lower than that suggested by experience with irreducible track maintenance requirements on branch line mileage in the United States. Accordingly it will be adjusted upward in the size related track maintenance and depreciation expense estimated in Memorandum No. 2.

To check the validity of the new track

maintenance equation in describing the behavior of cost in western Canada, we also fitted regression equations to western and eastern Canada separately. The most significant regression for western Canada is the following:

The dependent variable is Track Maintenance. The independent variables and their coefficients are the following:

202B

Variables	Value of Coefficients	Standard Error	Value of T
1. Constant	$1,020,290	$839,800	1.21
2. Investment in Tunnels, Bridges & Culverts	0.08752	0.03323	2.63
3. Yard and Train Switching Miles	0.9288	0.3410	2.72
4. Miles of Track per 100 dollars of Investment in Tunnels, Bridges and Culverts	0.4615	0.1853	2.49

The value of R^2 with 15 observations (West only) was .6039. Each of the values of T for the three variables other than the constant indicate the regression coefficients are significantly different from zero at the 5 per cent probability level.

A comparison of this equation with that presented by CPR (202) and with the equation we actually use (202A) reveals the following:

Both equations 202 and 202A may actually overstate the statistical variability of track maintenance expense with miles of track in Western Canada.

This is seen by comparing the regression coefficient for this variable in 202A and 202B. Second, the equation for Western Canada indicates that differences in gross ton miles among divisions are not useful in explaining differences in track maintenance. It will be noticed that the GTM variable is absent from 202B as its coefficient was not found to be significant. In 202B, the only output variable which is useful in explaining differences in track maintenance is yard and train switching miles. This indicates that 202 and 202A may overstate the amount of track maintenance expense allocated to output. The significance of the GTM variable in 202 and 202A is apparently due to its high correlation with track maintenance expense in Eastern Canada. We conclude then that the use of 202A in place of 202 gets us closer to a true picture of the statistical variability of track maintenance cost with output and track mileage in the system as a whole. It may nevertheless still overstate this variability in western Canada.

5. Account No. 235-266 - Shops and Enginehouses Maintenance and Depreciation

The next model to be revised was that which allocated Accounts 235-266 Maintenance and Depreciation of Shops and Enginehouses to output units. As revised for exhibit 132, the CPR used the following equation where Shops & Enginehouses M. & D. is the dependent variable.

235

Independent Variables	Value of Coefficients	Standard Error	Value of T
Constant	$24,360	$105,448	0.23
Direct Equipment Maintenance	0.05230	0.00573	9.13

With 10 district observations, the value of R^2 = .912.

In our corrected model, we found that Shops and Enginehouses M & D is explained by the Investment in Shops and Enginehouses in each division. This expense account is available on a division breakdown and this is what we used. There is a separate equation for the Western and Eastern regions of the railway. The Investment in Shops and Enginehouses is in turn related by a regression for the system as a whole to Yard and Train switching Miles. A substitution is then made by which Shops and Enginehouses M & D are related to the Switching Mile Output Variable. This model is shown below. The dependent variable is Shops & Enginehouses M & D.

235A

R^2		Variables	Value of Coefficients	Standard Error	Value of T
West:	.8874	Investment in Shops and Enginehouses	$0.05815	$ 0.00575	10.11
		Constant	5,436.40	56,430.00	0.09
East:	.9168	Investment in Shops & Enginehouses	0.06763	0.00644	10.50
		Constant	17,271.00	35,000.90	0.49

Finally, the system relation between Investment in Shops and Enginehouses and Switching Miles follows. The dependent variable is Investment in Shops and Enginehouses.

R^2		Independent Variables	Value of Coefficients	Standard Error	Value of T
System:	.2603	Yard and Train Switching Miles	$ 1.7643	$ 0.4308	4.09
		Constant	657,100.00	2,050,000.00	0.32

The substitution of the above equation into 235A for the West yields the following equation used to allocate this expense item to output:

West: Shops & Enginehouses M & D = $.10259 x yard and train switching miles + $43,646.00.

Substitution of the Investment equation into equation 235A for the East yields the following equation:

East: Shops & Enginehouses M & D = $.11932 x yd. and train switching miles + $61,711.

6. Account Nos. 253-266 - Power Plants, Maintenance and Depreciation

In the CPR exhibit, this variable is related through regression to Account No. 373, Station Employee Expenses. It was allocated directly to grain by substituting into the equation the allocated amount from Account 373. The CPR equation with accounts 253-266 as dependent variable follows:

253

R^2	Independent Variables	Value of Coefficients	Standard Error	Value of T
0.737	Account 373 - dollars of Station Employees Expenses	$0.01546	$0.00171	9.04
	Constant	Not significant		

In the revision we have carried out, this expense account is related in the West to Investment in Power Plants. Investment in power plants is then related to Investment in Shops and Enginehouses and to yard and train switching miles. In the East, Power Plant M & D is not significantly related to Investment in Power Plants. It is however, related to Dispatching and Station Employees Expenses, accts. no. (372-373-376). In allocating this expense to total variable expense in the East, the same procedure would be adopted as that used by CPR. First determine the dollars of (272-3-6) variable with output and then substitute in the Eastern equation for 253-266. The CPR equation for 253-266 is a clear example of their

use of a relation which holds in the East to explain variability in the West. The purpose of the following split is to get a more accurate determinant of the variability of 253-266 in the West. The revised equations are shown for East and West.

253A

	R^2	Independent Variables	Value of Coefficients	Standard Error	Value of T
West	.7982	Investment in Power Plants	$0.08702	$0.01214	7.17
		Constant	4189.19	13,002	0.32
East	.4979	Dispatching and Station Employees Expense	0.008413	0.002672	3.15
		Constant	-7983.82	11,070.7	-0.72

When the relation between Investment in Power Plants and switching miles is substituted in 253A (West) the following equation results for the West.

West: Power Plant M & D - $3547.14 + $.012699 x yard and train switching miles.

When the equation which determines the value of dispatching and station employees expenses is substituted into 253A (East), the following equation results for the East.

Power Plant M & D = $2325.03 + $0.4940 x LCL cars loaded + 0004748 x GTM (000).

The equation determining Dispatching and Station Employees Expenses is discussed below.

7. Account Nos. 372-373-376 - Dispatching and Station Employees Expenses

In the CPR exhibit Dispatching and Station Employees Expenses (Accts. 372-373-376) are explained by three independent variables. Those are shown below.

372-3-6

R^2	Independent Variable	Value of Coefficient	Standard Error	Value of T
.539	Constant	$624,995	$510,830	1.22
	Passenger Car Miles	0.02336	0.01430	1.63
	Cars L.C.L.	65.35356	16.44774	3.97
	Carloads	5.61490	3.66231	1.53

It can be seen that the CPR chose to allocate expenses from Accts. 372-3-6 to two output variables whose coefficients are not significantly different from zero in the statistical sense at the 5 per cent probability level. These are passenger car-miles, whose coefficient has a T-value of 1.63 and carloads, whose coefficient has a T-value of 1.53. With 27 observations, and 23 degrees of freedom, the 5 per cent significance level of T is 2.07. A T-value of 1.63 is significantly different from zero at the 11 per cent probability level. A T-value of 1.52 is significantly different from zero at the 14 per cent probability level. We shall indicate in a separate section below why we feel it is somewhat questionable to accept T-values which fail to exceed the 5 per cent

probability level of significance.

The major reason for revising this equation is to arrive at an allocation based on statistically significant estimates of the unit cost coefficients. The equation we have used is a system equation relating account 372-3-6 to two independent variables: Investment in Station and Office Buildings and L.C.L. cars loaded. In turn, the Investment in Station and Office Buildings for the system is related to an output unit, gross ton-mils.

	R^2	Dependent Variable	Independent Variables	Value of Coefficient	Standard Error	Value of T
System	.7905	Dispatching & Station Employees Expenses	Investment in Station and Office Bldgs	$0.2839	$0.0447	6.35
			Cars Loaded L.C.L.	58.72	10.75	5.46
			Constant	439,862.	623,706	0.71
System	.2028	Investment in Station and Office Bldgs	GTM (1 frt. and 2 pass)	$ 0.19879	$0.07884	2.52
			Constant	2,766,771	2,713,360	1.02

When the equation explaining the variability of investment is substituted into the equation explaining (372-3-6), the following equation results for the system:

System Dispatching and Station Employees = $1,225,348 + $58.72 x LCL Carloads + .05644 x GTM (000)

8. Account Nos. 398-400 Train Locomotive Supplies, Train Enginehouse Expenses

In the CPR exhibit 132, account Nos. 398-400 are explained by two independent variables: Locomotive Miles Steam, and Locomotive Miles Diesel. The following equation was used:

398-400

R^2	Independent Variable	Value of Coefficient	Standard Error	Value of T
.571	Constant	$ 161,051	$784,649	0.21
	Loco Miles Steam	0.21240	0.10930	1.94
	Loco Miles Diesel	0.12959	0.06929	1.87

This regression was derived from the observation on 10 districts, as the expense data are not maintained for individual divisions. It can be seen that the T-values for the two regression coefficients are not significant at the 5 per cent level. With 10 observations, and 7 degrees of freedom, the 5 per cent significance level of T is 2.365. The T-value of 1.87 is significantly different from zero only at the 10 per cent probability level, while the T-value of 1.94 is significant only at the 8 per cent level.

The CPR regression was modified in two ways: First, we used a single independent variable, total locomotive miles, steam plus diesel. This permitted us to estimate a statistically significant unit cost coefficient. Second, we eliminated the observation on the Quebec district from the sample of observations. This was done after examination of the scatter diagram

between account 398-400 and the independent variable. It was clear that the cost-output relation in the Quebec district is not typical of the rest of the railway's operations. The average expense per locomotive mile in the Quebec district is $0.4299. In the other 9 districts it is $0.1519. It is clear that the operations of the CPR in the Quebec district have led to expenses in this category which are not related to the service units performed in the district. The explanation appears to be the location of CPR's major locomotive repair facility in the Quebec district. Accordingly the observation on the Quebec district was deleted from the sample prior to estimation of the cost coefficient. The expenses in Quebec which are over and above those predicted by the regression are then regarded as a constant to be borne equally by all the other divisions.

The cost equation we derived follows. The dependent variable is Train Locomotive Supplies and Train Enginehouse Expenses.

Dependent Variable	R^2	Independent Variable	Value of Coefficient	Standard Error	Value of T
398-400	.8178	Loco Miles	$0.13410	$0.02392	5.61
Train Loco Supplies & Train Engine-house Expenses		Steam and Diesel			
		Constant	726,630	1,748,190	0.42

9. Gross Investment in Road Property

In explaining the variability of Gross Investment in Road Property the CPR presents the following regression model. The dependent variable is Gross Investment in Road Property.

R^2	Independent Variables	Value of Coefficient	Standard Error	Value of T
.753	Constant	$34,125,798	$12,769,530	2.67
	Miles of Track	15,130,387	4462.9432	3.39
	GTM (total)	4.35896	0.85372	5.11
	Yd. and Train Swg. Miles	12.6634	6.77310	1.87

The CPR allocated a portion of the variability of Gross Investment to yard and train switching miles. In exhibit 408, this is shown as an expense of $914,738. This allocation is invalid in view of the fact that their regression coefficient for this output unit is not significantly different from zero, at the 5 per cent probability level. With 23 degrees of freedom, the T-value of 1.87 is significant only at the 7 per cent probability level.

In correcting this equation we found that different output and size units explained the variability of investment in the west and the east. In the west, it is explained by gross ton miles and miles of track. In the east it is explained by gross ton miles alone; miles of track was not found to have a significant coefficient in the east. The equations

we derived are shown below:

Dependent Variable	R^2	Independent Variable	Value of Coefficient	Standard Error	Value of T
Gross Investment in Road Property West	.6859	GTM (1 Frt. + 2 Pass)	$ 3.4360	$0.9337	3.68
		Miles of Track	12,520	5,491	2.28
		Constant	60,550,000	21,904,400	2.76
Gross Investment in Road Property East		GTM (1 Frt. + 2 Pass.)	$ 6.6080	$1.2160	5.43
	.7470	Constant	48,648,700	22,730,000	2.14

10. The Use of the 5 Per Cent Probability Level as a Criterion of Statistical Significance.

We have already shown that the CPR has allocated a substantial sum of costs to the grain traffic on the basis of regression coefficients which fail the significance test based on a 5 per cent probability level. These allocations are summarized below.

Cost Equation	Independent Variable	Cost Allocation to Grain
1. Dispatching and Station	Passenger Car-Miles	none
Employees expenses	Carloads	$1,037,764
2. Train Locomotive Supplies and Train Enginehouse Expenses	Loco Miles Steam	
	Loco Miles Diesel	724,073
3. Gross Investment in Road Property	Yard and Train Switching Miles	879,399
	Total	$2,641,236

In his cross-examination, pages 11,749 - 11,751, Mr. Stenason justified the retention of these coefficients. He argued, page 11,750, "The probable value was set by the analysts depending on the experiment and depending on the factors which are in the study." This is hardly an explanation of why a particular probability level was chosen.

Statisticians have typically used either a 5 per cent or a 1 per cent probability level in tests of significance involving such distributions as that underlying the T-test. In order to understand why these levels are used it is necessary to state the philosophy underlying the procedure of hypothesis testing as it is currently employed.

In estimating unit cost coefficient for railway operation it is clear what sort of error we wish to avoid. This is the error of allocating to a particular study traffic items of cost which are unrelated to that traffic. This means that we must keep as low as possible the probability of accepting a regression coefficient as having a non-zero value when in fact it is drawn from a population with a true mean of zero. This safeguard is carried out by requiring any regression coefficient to exceed its standard error by enough of a margin so that we may confidently say it has not been drawn from a population with a mean of zero. That is to say if the ratio of the coefficient to its standard error is 3, there is a smaller probability that it was drawn from

a population with mean zero than if the ratio was 2. The extent to which the coefficient must exceed its standard error is determined by the probability distribution the coefficient possesses. We then attach a probability index to the variable and say: With this value of the regression coefficient and its standard error, the probability of drawing as large a value from a population with mean zero is such and such. The greater is this ratio of the coefficient to its standard error, the smaller the probability it came from this population with mean zero. Using the T-distribution as an example, with 23 degrees of freedom, we obtain the following relation between sample values of t (in this case the ratio of the regression coefficient to its standard error) and the probability it was drawn from a population with mean zero.

t	Probability of drawing as large a value of t (sign ignored) from a population with mean zero
.685	50%
.858	40%
1.060	30%
1.319	20%
1.714	10%
2.069	5%

The smaller the probability level we assign the larger must be the value of t.

The significance test is performed by specifying in advance the critical probability level at which

one is willing to say that this value of t did not come from this population. If 5 per cent were chosen as the critical probability level, then any value of t which exceeded 2.069 would indicate to us that it was not very likely drawn from this population.

Now it is true that there are no a priori grounds on which to choose one probability level of significance over another. The 5 per cent and 1 per cent levels have been used as a matter of practice because they have proven to be economic levels of significance. There is a cost attached to rejecting true hypotheses, and these levels seem to provide a good solution. The point which must be made clear is that the CPR statisticians did not very likely state in advance what significance level they regarded as critical. It appears that their acceptance of regression coefficients which are significant at 7, or 11 per cent was made after the machine computations were performed and the regression results printed out. Their justification for the acceptance of t values which do not exceed the 5 per cent level is therefore questionable. For they have increased beyond 5 per cent the probability that the regression coefficients they accepted did in fact come from populations with zero means. They have increased rather than reduced the probability of rejecting a true hypothesis (namely that t = 0) when on grounds of objectivity they should seek to avoid at all costs the imputation of expenses to study traffic based on unit cost coefficients which

are fallacious.

It is on these grounds that we argue that the CPR statisticians have not given convincing reasons for accepting regression coefficients which would be rejected when the 5 per cent critical probability level is employed.

11. Cost Variaions Resting Upon Choice of Output Units.

It has been suggested that the use of gross ton-miles as an output unit overestimates the cost of handling grain. The argument is that grain as a heavy loading commodity requires fewer cars than other commodities. Therefore the use of car-miles as an output unit instead of gross ton-miles would give a different picture of the cost of carrying grain. Calculations which we have made indicate that total variable grain costs would be reduced by some $1,366,375, if the substitutions were made. In the interests of providing conservative estimates of grain's costs, we have not incorporated this change into our formal presentation. Nevertheless, it should be noted that such an additional saving is possible with a reasonable substitution of one service unit for another. The savings would be even larger if GTM had originally been used as an explanatory variable throughout the study.

While conventional practice employs GTM to explain running track maintenance, it cannot be

presumed that GTM is the sole, or even the principal, explanatory variable for this expense category. While it is true that the expense depends on the weight of cars passing over the rail, it also depends on the number of cars passing over, and the speed of the trains they move in. While grain cars are heavier than other loads, there are nevertheless fewer cars required to transport a given number of GTM of grain.

In the CPR regressions, GTM is used to allocate the costs of the following accounts:

Account	Cost per GTM (000) including where necessary adjustment for superintendence and system level expenses. (Exhibits 63-R and 66-R)
Track Maintenance and Depreciation	$ 0.17575
Investment in Work Equipment - Cost of Money	0.00786
Investment in Road Property - Cost of Money	0.28926
	$ 0.47287

Multiplying the total coefficient by 12,233,795 of GTM (000) of grain traffic yields a cost of $5,784,995.

In order to determine the effect of using car miles instead of GTM as the output variable here, we calculated the number of gross ton miles of grain and of all traffic equivalent to a car mile of traffic.

For grain we derived from the CPR Memorandum "In Respect of Results of Cost Study" an average load of 54 tons per car, with tare weight of 23 tons. We

used 57.73% as the ratio of empty to loaded car miles.

1 average car-mile of grain = .6340 x 77 tons
+ .3660 x 23 tons
(loaded) (empty)

= 57.24 gross ton miles

For every car mile, there are .6340 loaded miles and .3660 empty miles.

For the system, we assumed an average load of 31.39 tons per car. This is derived from the CPR report to the Board of Transport Commissioners; we took the tare weight as 23 tons. We used 51.64 per cent as the ratio of empty to loaded car miles. This ratio is also taken from the B.T.C. report.

1 average car-mile of system traffic = .6594 x 54.39
+ .3406 x 23
= 43.6986 GTM.

We multiplied the unit cost coefficient of .47287 per GTM (000) by .0436986 GTM (000) / car mile to obtain a figure of .020664 per car mile.

This is then multiplied by 213,831,793 car-miles of grain traffic to obtain an allocation of $4,418,620. This is smaller than the allocation based on GTM by $1,366,375.

Finally, it should be noted that substitution of car-miles for GTM as an output unit does not change the regression results. This was confirmed by calculations indicating that the ratio of GTM to car-miles is roughly constant among all divisions of the CPR.

Q. Dr. Borts, at page 20 of your brief there appears, "The Effects of Multiple Car Cuts on Classification Switching Costs."

A. I would like to make one point in this regard re multiple car cuts. It looks as if I have spent a tremendous amount of time on this problem, compared to the amount of cost which is imputed to this sector of railway hauling. I should point out that the reason why I put so much effort into the question of multiple car cuts and the economies therefrom is from the vehement denial of the witnesses from both railway companies that anything of the sort existed. I felt that a much greater burden of evidence is on you when you come up against the denial of people that something exists, as opposed to when you are following a line of inquiry that they have already opened up. I would appreciate it in reading this that you bear in mind that the amount of time and effort spent in this is simply the result of the fact that there is a point to be made here which I think should be fairly obvious, and that we have tried to explore it to its ultimate depth.

Now, I would like to continue by indicating what the point is. The point is ---

MR. SINCLAIR: I would like to assure Dr. Borts that the ultimate depth that he puts has not been explored.

MR. MAURO: Perhaps my learned friend will wait for his opportunity to cross-examine.

THE WITNESS: Let me correct myself -- in so far as information is presently available.

MR. MAURO: Dr. Borts, you do not have to answer questions at this time.

THE WITNESS: The point very simply is this, that in a switching yard, if the engine crew is cutting out two cars at once, it should not take twice the time that it takes to cut out one car.

Q. That it should not take ---

A. It should not take twice the time to cut out two cars at once as it does to cut out one car.

Q. And that is the rationale?

A. That is the only point which is being made here. What I have done is to review past studies by some eminent people.

Q. Could you name one or two?

A. There is Mr. Wright, Mr. Poole and Mr. Stenason and Mr. Myer.

Q. Was that the Mr. Stenason who appeared for C.P.R.?

A. I believe so, yes.

In each of these studies we are making an estimate of the extent to which a saving is possible in the minutes per car. Obviously, if it took no extra time to cut out two cars as opposed to one car, you would say 50 per cent in minutes per car in a two-car cut over a one-car cut.

THE CHAIRMAN: Mr. Wright was the man who wrote the article?

MR. MAURO: Yes. Mr. Stenason was the man who participated in the writing of the book..

THE CHAIRMAN: We know him.

THE WITNESS: I would like to go through this in some detail to see the way in which this was brought in to our own study.

12. The Effects of Multiple Car Cuts on Classification Switching Costs

A. In their allocation of switch engine time to the classification of grain cars, both the CPR and CNR ignore the economies of multiple car cuts. A sampling of the records of the CPR indicate that the grain cars are handled in larger size cuts then cars of other traffic.

I might interpolate that this is very reasonable and I think most people in the grain trade have this before their very eyes.

The sampling was made for three yards over a 4-day period corresponding to the days used by the CPR in their own study of switching time.

In addition, the cross-examination of Mr. Bandeen by Mr. Cumming (pages 13185, 13186) reveals the same phenomenon on the CNR; that is, larger cuts in grain cards at least for their Winnipeg yard..

The following tabulation, which is on page 21, shows the average size of cut for three yards of the CPR and for the Winnipeg yard of the CNR. For each of the three yards of the CPR the average is derived by taking the ratio of total cars received over the 4-day

period to total cuts performed on such cars over the same period. It is not known how the CNR ratio is derived.

MR. SINCLAIR: I wonder if my friend would permit me to ask whether this includes or excludes yard transfers, or is it only loads brought in by train.

THE WITNESS: I would like to give that only a provisional answer because the effort involved in preparing the data was a joint effort, while the effort involved in analysing the data is my own.

Provisionally, I would say that the information refers only to cars brought into the yard.

MR. SINCLAIR: That means you exclude yard transfer?

THE WITNESS: As far as I understand the term, yes. If the answer is incorrect, I will correct that answer.

MR. MAURO: Q. Or would Mr. Banks be better able to give that information?

A. Well, we will find out.

COMMISSIONER BALCH: Might I ask a question? I understand this gentleman is dealing with car cuts; actual switching. Isn't that what this is dealing with now, the actual switching? Mr. Sinclair, I am asking you why you are bringing in the transfer into it.

MR. SINCLAIR: I am just trying to understand what the figures are in here and the question I

put in was there yard transfers involved in the data presented here, or was it merely based on cars arriving by trains and not by transfers. The answer is, provisionally, subject to check, that it applies only to cars arriving by trains.

COMMISSIONER BALCH: Thank you.

MR. MAURO: Q. Following up what Commissioner Balch has asked, this study, though, is the savings on multiple car cuts?

A. That is right.

Q. For whatever reason -- whether they are being transferred into the same yard --- ?

A. The question is what does the data refer to, and it is appropriate, and this would come up in ---

Q. Would you speak up, please, Dr. Borts?

A. It is an appropriate question, and, as you say no matter what cars we are referring to it is the saving in multiple car cuts.

Q. Yes. Carry on, Dr. Borts.

A. Yes.

Average Cars per cut in
Classification Switching of Through Cars

Yard	All Loads and Empties	All Loads	Grain Loads
Calgary	2.5346	2.3926	3.3494
Saskatoon(Sutherland)	2.5538	2.5679	2.9020
Souris	4.0303	3.1698	7.1795
Winnipeg - CNR	2.70	not known	4.20

[illegible]

The CPR method of allocating switch engine time is to take the yard average classification engine minutes per car. To the extent that engine minutes per car are lower in large size cuts the CPR method overstates the minutes alloeable to grain cars.

As you can see in this tabulation on page 21, average size of grain loads -- that is, the average number of cars per cut in grain loads -- exceeds substantially the average size of all those in the empties, or the average size of cuts in all these.

Q. It ranges from 2.9 in Saskatoon referring to grain loads to 7 cars in the Souris yard?

A. Yes, approximately, 7.1.

As seen above grain carloads were handled in larger cuts than other loads.

It is likely that the average cut sizes shown above understate the difference between grain and non-grain traffic on the CPR. The reason for this is that grain averages shown for the CPR yards refer to loaded cars only, (that is, the grain averages refer to loaded cars only.) The CPR records do not permit the identification of empty cars in the grain service. It is likely that the size of cut on empty cars in the grain service is larger than the size of cut of loaded grain cars. I am informed that it is not typical or common practice for a railway to classify empty cars by destination. For this reason the average size of cut of grain carloads understates the average size

of cut of all cars in the grain service. To this extent, the economies of larger cut which we estimate below are conservative, and understate the savings which are likely to occur in the grain service.

Now, I would like to refer only very briefly to the studies which we examined. There are two types of switching yards which are in use both in the Canadian Pacific and Canadian National. One is called the flat yard and the other is called the hump unit, and it is engineering experience -- it is backed up by statistical data which I examined -- that the savings in multiple car cuts are in fact larger on flat yards.

What we did, accordingly, was to prepare estimates for the two typesof yards separately. Starting with paragraph B, page 22, I discuss a study of savings in multiple car cuts which were estimated by Mr. Wright in a study of operations on the Chesapeake & Ohio Railway. The savings which he derives are illustrated on page 24 of my brief, where I have taken the percentage savings as indicative of the type of savings you might expect on any flat yard.

If we put in the experience of that yard in terms of the average size of all cuts and the average size of the cuts of grain service ---

MR. SINCLAIR: What yard?

MR. MAURO: Q. In the case of Calgary, it is the Calgary yard?

A. What we have done is use the Calgary experience as indicative of what would happen at a yard, and there we show a saving of 19 per cent in minutes per car. On the basis of Saskatoon experience we would have a saving of 9½ per cent. In Souris, the experience of saving would be 31 per cent; and Winnipeg experienced a saving of 28 per cent.

Q. They are taken as indicative yards?

A. Each yard is used; the experience is used at the yard in terms of the difference between the cut size of cars in grain service and the cut size of cars in all service.

B. The amount of classification engine time saved in handling larger cuts has been estimated by different studies. Two of these were carried out for yard switching on American yards. We have also estimated the saving from the data on the Calgary yard. The three studies together permit a reasonable statement of the savings possible.

(1) Walter B. Wright carried out a study of classification switching in a flat yard of the Chesapeake and Ohio Railway. His article entitled "How Cars in Multiple Cut Costs", appeared in the January 4, 1960 issue of Railway Age.

Wright used the multiple regression technique to allocate cost to two dimensions of output in classification switching. These are the number of cuts and the size (number of cars) of cuts.

His conclusions are quoted (page 35):

"Note that the savings in engine minutes per car are quite striking when a cut contains two or three cars instead of one. The rate of saving is less noteworthy when one or two cars are added to a cut of, say 30 cars."

Wright developed a scale showing the calculated decrease in yard engine-minutes per car as the size of cut is increased in a flat yard. This scale shows the direct time associated with increases in the size of the cut. It is reproduced below. In addition, the direct engine times are computed for the relevant sizes of cut as they appeared in the Calgary, Saskatoon (Sutherland), and Souris yards, of the CPR, and in the Winnipeg yard of the CNR. The Calgary yard is a hump yard, not a flat yard. We shall use the experience at Calgary in terms of the average size of cut of grain cars to gain an estimate of the economies to be obtained in large flat yards. It is to be noted that the average size of cut of through traffic in a yard is not dependent on whether a yard is a flat yard or a hump yard. The average size of cut depends on the volume and commodity composition of the traffic, and upon the spatial distribution of extractive, processing and consuming points. For this reason the experience at Calgary is used as an estimate of the average cut size of grain cars in all large yards in the western region of the CPR. The experience at

Saskatoon and Souris will be used similarly to estimate the economies in medium and small flat yards.

It is, of course, not reasonable to apply directly to one flat yard the simple numerical results of a scale estimated from the operations of another flat yard. The reason is that yards differ in traffic volume, in traffic composition, in physical layout, and in motive power assigned. These will affect the engine minutes devoted to classification. What we propose to do is to show the percentage savings in classification engine time arising from larger cut sizes. This will be indicative of the economies that may be expected in CPR operations on grain cars in different size flat yards. The percentage savings are shown in a column following the engine minutes per car. The yard average and grain average cut sizes shown for the CPR and CNR yards are the same as developed on page 21.

Flat Yard Switching

Wright Scale: Calculated Decrease in Direct Yard-Engine

Minutes per Car, as Size of Cut is Increased

Number of Cars per Cut	Engine Minutes Per Cut: 3.16646 mins for the first car plus .28960 for each additional car	Average Engine Minutes per Car	Percent Average Engine Minutes Per Car is of Single Car Switch
1	3.16646	3.1665	100.00%
2	3.45606	1.7280	54.57%
3	3.74566	1.2485	39.43%
4	4.03526	1.0088	31.86%
5	4.32486	0.8650	27.32%
6	4.61446	0.7691	24.29%
7	4.90406	0.7006	22.13%
8	5.19366	0.6492	20.50%
9	5.48326	0.6092	19.24%
10	5.77286	0.5773	18.23%

			Saving
Calgary:			
Yard Average 2.5346	3.61088	1.42464	
Grain Loads 3.3494	3.84685	1.14852	19.38%
Saskatoon (Sutherland)			
Yard Average 2.5538	3.61644	1.41610	
Grain Loads 2.9020	3.71728	1.28094	9.54%
Souris			
Yard Average 4.0303	4.04403	1.00341	
Grain Loads 7.1795	4.95604	0.69030	31.20%
Winnipeg - CNR			
Yard Average 2.7	3.65878	1.35510	
Grain Loads 4.2	4.09318	0.97457	28.08%

Using the Wright scale it is clear that savings in direct time through larger size cuts are mathematically possible. On the basis of the Calgary experience there is a saving of 19.38%; Saskatoon experience suggests a saving of 9.54%; Souris a saving of 31.20%; and Winnipeg a saving of 28.08%.

It should be noted that in his cross-examination Mr. Bandeen incorrectly applied the simple numerical results of the Wright scale to the Winnipeg yard (page 13186). He concludes correctly that a saving of .38 minutes of direct time is in order, assuming that the Winnipeg contrast between grain and average traffic was experienced at the yard studied by Wright; but he fails to point out that it is the percentage rather than the absolute saving which must be applied, and commits the further error of applying Wright's scale, excluding overhead, to total switch engine time, including overhead, at Winnipeg. As indicated above, the reason why it is appropriate to apply percentage rather than absolute savings is the difference in yard characteristics which alter the engine minutes per car from one yard to the next. If the Wright scale is correctly applied to Bandeen's data, then far larger savings in engine minutes are suggested at CNR's Winnipeg yard. It will be shown below that the correct saving is 1.52 minutes per car, not .38 minutes as Mr. Bandeen claimed.

(ii) The Wright scale provides one estimate of the extent to which CPR has overstated the

cost at flat yards of classification switching of grain cars through the use of yard average minutes per car.

The cost research staff of the Southern Pacific Company under the direction of E. C. Poole have studied switching time in both hump yards and flat yards. Some of their data are used in The Economics of Competition in The Transportation Industries, by J. R. Meyer, J. Stenason, M. J. Peck, and C. Zwick. This book will be referred to henceforth as the Meyer-Stenason study.

The authors of the Meyer-Stenason study fitted multiple regression relations to the Poole data to determine the effect of variation in number of cars and number of cuts on the classification engine time. Data were available for both flat yard and hump yard operations. A lengthy quote from the book (page 312, ff.) will indicate their findings:

> "A . . . (multiple regression) analysis for flat switching yards yields the following results:
>
> $$M = 3.067 - \underset{(.1041)}{.0329}\,(\text{cars}) + \underset{(.178)}{.626}\,(\text{cuts}) \qquad R^2 = .355$$
>
> where M is engine minutes per block of cars.
>
> Apparently the number of cars does not influence the amount of time consumed in flat switching yard operations: the coefficient for the number of cars is both an

> inadmissible negative and statistically insignificant. This is not surprising since it conforms with other knowledge about the character of switching operations. In short the number of cuts is unquestionably the dominant variable in flat switching classification."

It is possible to develop a scale from the data of the Poole study as quoted in the Meyer-Stenason book. This scale, as the Wright scale, shows substantial economies to be derived from increasing the size of the cut in flat yards.

The size of the cut may be increased by adding cars to a given number of cuts or by reducing the number of cuts performed on a given number of cars. On the basis of the Meyer-Stenason-Poole equation, one less cut saves .626 minutes, while an extra car costs nothing in engine minutes. I am informed that the latter result is not supported by operating experience. Nevertheless a scale may be constructed on the assumption that the number of cars handled is held constant at the sample average of 17.10 cars per observation. The size of the cut is varied by changing the number of cuts. It should be noted that the scale would not change if it were assumed instead that the cuts are held constant and the number of cars are varied.

Now, the second study which we investigated was one which was prepared in a book called "The

Economies of Competition in the Transportation Industries", and it has four authors: Mr. Meyer, Mr. Stenason, Mr. peck, and Mr. Zwick.

This study makes use of data which w originally prepared by the research staff of the Southern Pacific Company under the direction of E. C. Poole, and only the data were prepared. The actual fitting of the equations by least squares methods and the computation of the cost scales -- I am sorry, the fitting of the equations were made by the authors of this book and presented in the book.

Q. At page 27 of your paper?

A. Yes, page 27 of my paper. What I have done there is to derive, again, the cost scale similar to the one derived from the Wright equation, where the origin of this cost scale is the equation which is in the Meyer, Stenason, peck, Zwick book.

This shows for Calgary, on the basis of Calgary experience, a saving in minutes per car of 24 per cent; for Saskatcoon, a saving of 11.8 per cent; Souris, a saving of nearly 44 per cent; Winnipeg, a saving of nearly 36 per cent.

Q. I notice in each of these you have used the Meyer-Stenason method, in each case, and it is a greater saving than if you used the Wright formula?

A. Yes.

Now, going now from flat yards to hump yards, we again have two studies which permit the

derivation of a scale of this sort: the Meyer-Stenason study, as data from the Southern Pacific Company, on the possible savings in hump yard switching and this permitted him to derive a scale which is shown on page 29.

MR. SINCLAIR: I wonder if my friends would allow me to follow here. In the Wright study and in the Poole basis for Southern Pacific, do you know how many yards were involved as the basis for the scale?

THE WITNESS: No, sir.

MR. MAURO: No, he does not know.

MR. SINCLAIR: Thank you.

THE WITNESS: I think that information again I might be able to find out, but I do not know if the information itself is given in the original article.

MR. MAURO: Q. If it is available ---

A. If it is available we will give it to you, yes.

Q. You will advise my learned friend?

A. Yes, I will ask to have it put into the record if it is available.

Flat Yard Switching

Meyer-Stenason-Poole Scale: Calculated Decrease in Direct

Yard-Engine Minutes per car, as Size of Cut is Increased

No. of Cars per cut	No. of Cuts	Total Direct Time = no. of cuts x .626	Direct Engine Minutes per cut	Direct Engine Minutes per car	Percent Avg. Eng. Mins. per car is of single car switch
1	17.10	10.7046	0.626	.626	100%
2	8.55	5.3523		.313	50%
3	5.70	3.5682		.209	33%
4	4.27	2.6730		.156	25%
5	3.42	2.1409		.125	20%
6	2.85	1.7841		.104	17%
7	2.44	1.5274		.089	14%
8	2.14	1.3396		.078	12%
Calgary					
Yard Average					Saving
2.5346	6.75	4.2255		.247	
Grain					24.29%
3.3494	5.11	3.1989		.187	
Saskatoon					
Yard Average					
2.5538	6.70	4.1942		.245	
Grain					11.84%
2.9020	5.89	3.6871		.216	
Souris					
Yard Average					
4.0303	4.24	2.6542		.155	
Grain					43.87%
7.1795	2.38	1.4899		.087	
Winnipeg - CNR					
Yard Average					
2.7	6.33	3.9626		.232	
Grain					35.78%
4.2	4.07	2.5478		.149	

It can be seen from this scale that savings in direct time through larger size cuts are mathematically possible. On the basis of the Calgary experience, there is a saving of 24.29 per cent; Saskatoon experience suggests a saving of 11.84 per cent; Souris experience suggests a saving of 43.87 per cent, and Winnipeg a saving of 35.78 per cent.

(iii) The authors of the Meyer-Stenason study also developed an equation for hump yard operations from the data of the Poole study. This equation as the previous equation for flat yards was fitted by multiple regression methods.

$$M = 1.962 + \underset{(0.04694)}{0.1384}\,(\text{cars}) + \underset{(0.05216)}{0.1424}\,(\text{cuts})$$

$R^2 = .828$

M is engine minutes per block of cars.

On the basis of this equation we may develop a scale for hump yard operation. This will show the economies in minutes per car to be derived from the increases in the size of the cut. In the scale, it is assumed that the size of the cut is varied by holding the number of cars constant at the mean level (28.79 cars per block) and varying the number of cuts. The same scale of minutes per car would be obtained if instead we held constant the number of cuts and varied the number of cars.

At the bottom of the scale we have estimated the saving in engine time resulting from handling the larger grain cuts at the Calgary yard. This is the

only hump yard on the CPR for which the information on cut size is available.

Q. You were discussing, Dr. Borts, the hump yard situation, page 29?

A. Yes. In the scale presented on page 29, it again is derived from the Meyer-Stenason book which they based on E. C. Poole's data. I, again, have derived the percentage savings in minutes per car arising from the larger size of cut in the grain service, and as you can see the percentage savings are smaller than previously, which is in accordance with what is accepted in these yards.

Q. I notice when you get to eight cars per cut the savings just about disappear?

A. Yes, the savings just about disappear.

Q. You reach a point of diminishing returns in the saving factor?

A. Yes, in a sense. In this, also, I have only computed the savings for the Calgary yard, which is a hump yard of the Canadian Pacific Railway and we want to use this as a measure of hump yard experience.

Borts, dir 19166
(Mauro)

Meyer-Stenason-Poole Scale: Hump Yard Switching

Calgulated Decrease in Direct Yard Engine Minutes per Car, as Size of Cut is Increased

No. of Cars Per Cut	No. of Cuts	Total Direct Time *	Direct Engine Minutes Per Cut	Direct Engine Minutes per Car	Percent Avg. Eng. Mins. per car is of single car switch
1	28.79	8.0842	.281	.281	100%
2	14.39	6.0336	.419	.210	74.7%
3	9.60	5.3515	.557	.186	66.2%
4	7.20	5.0098	.696	.174	61.9%
5	5.76	4.8047	.834	.167	59.4%
6	4.80	4.6680	.972	.162	57.7%
7	4.11	4.5698	1.112	.159	56.6%
8	3.60	4.4971	1.249	.156	55.5%

Calgary

Yard Average					
2.5346	11.36	5.6022	.493	.195	Saving 7.18%
Grain Loads					
3.3494	8.60	5.2091	.606	.181	

* Total Direct Time = 0.1384 x 28.79 + 0.1424 x no. of cuts

= 3.9845 + .1424 x no. of cuts

It can be seen that savings of 7% in engine time are mathematically possible on the basis of the Calgary experience.

MR. SINCLAIR: May I ask, again, to help me as I go along, do you know whether the data which you based your savings on were on mechanical humps or manual humps?

THE WITNESS: I do not know, sir, and the data on the Calgary yards were taken from the four days in which the Canadian Pacific Railway studied switching at the Calgary yard. As far as I recollect, the work sheets which the company provided did not contain that information.

MR. SINCLAIR: I am sorry. You misunderstood me.

THE WITNESS: Are you thinking -- you are talking about the Poole scale?

MR. SINCLAIR: Yes. I know what the Calgary is.

THE WITNESS: Oh, okay.

COMMISSIONER BALCH: Is the Calgary yard a mechanical hump?

MR. SINCLAIR: No, sir, it is not. No, sir.

THE WITNESS: Would you repeat the question, please?

MR. SINCLAIR: I was asking if the data on the scales on the Southern Pacific was based on mechanical or manual humps.

Q. Carry on, Mr. Borts.

A. We also have this information on the Calgary hump yard mainly.

Q. Mainly hump in Calgary?

A. Yes.

MR. SINCLAIR: There are different kinds of these, I call it with riders.

MR. MAURO: I might say if my learned friend has questions if he would like to write them out on this type of thing since Dr. Borts is not being cross-examined immediately, we will try and get all the answers for him.

MR. SINCLAIR: I have just had an idea, I happen to know Dr. Poole and I can call him on the telephone just as easy as Dr. Borts.

THE WITNESS: Observations on the Calgary yard on the C.P.R. This is a hump yard. These consist of twelve separate eight hour sifts over a four day period; they correspond to the days used in the CPR study of switching time. The data were taken from the records.

The equation attempts to classify switching time into the two components of service; the number of cars handled and the size of the cut. As fitted by multiple regression techniques the resulting equation is:

$$[R^2 = .91] \quad \text{Minutes} = \underset{(.2233)}{.9268}\,(\text{cars}) + \underset{(744.30)}{2,680.54}\,(\text{cuts/car}) + \underset{(144.11)}{1,091.0467}$$

[illegible]

This equation is subject to the same qualifications as that imposed in the Meyer-Stenason study on their flat yard equation. It appears that adding cars to a given number of cuts would reduce the engine time. This result may simply indicate a higher degree of overcapacity during certain shifts - overcapacity which is not within the railway's power to correct in view of the heavy number of cars it must be prepared to handle in the day shift relative to the number handled at night. In the Calgary yard the average number of cards handled in day shifts was 627 per shift with a maximum of 784, while at night the average number was 171 with a minimum of 110. This explanation is borne out by the marginal cost function for handling cars which can be derived from the above equation. This marginal cost function is derived from the switching equation by taking the partial derivative of the switching equation with respect to cars, holding the number of cuts constant. W.A. Granville, P.F. Smith, W.R. Longley, Elements of Calculus, Ginn and Co., 1946, Chap. 23. We have

$$\text{Marginal Cost of Cars} = .9268 - 2,680.54 \frac{\text{Cuts}}{(\text{Cars})^2}$$

It can be seen that this is an upward sloping curve, because the sum of the terms increase in value as the number of cars increase. It can also be seen that if we substitute the mean values of cars (378.5) and cuts (149.33), we obtain a negative value for the marginal cost of -1.87 minutes.

However, this equation is an increasing function of the number of cars handled. When the number of cars handled in a shift equals 658, the number of cuts remaining at 149.33, the marginal cost is zero, and when the number of cars exceeds 658, the marginal cost is positive.

This marginal cost equation for cars is consistent with the mathematical finding of the Meyer-Stenason study for flat yards that it costs nothing to handle an extra car. It is also consistent with the proposition that the Calgary yard seems prepared to handle more than 650 cars in a single shift. These findings indicate the possibility that the Calgary yard was not operating at its designed capacity rate during the study period. If the yard were operating at capacity, unit costs of classification switching would be lower than actually reported by the CPR.

The above equation may be used to derive a switching scale similar to the previous scales. It shows the reduction in direct engine minutes per car from a larger size cut. The reduction is estimated by holding the number of cars constant at the yard average of 378.5 per shift, and varying the number of cuts. This scale shows percentage savings in direct time which are similar to those shown in the Wright scale and the Meyer-Stenason-Poole scales. Again the scale is applied only to the Calgary yard as this is the only CPR hump yard for which

information on cut-size is available.

It should be noted that the equation derived from Calgary data does not permit a simple partition of engine time between overhead, cars, and cuts. The reason was pointed out earlier. At the mean levels of yard output, the marginal cost of cars is negative. Consequently, engine time cannot be allocated to cars on a marginal time basis at the yard mean levels of output.

Borts Scale for Calgary 1. Calculated Decrease in Direct Yard

Engine Minutes per Car as Size of Cut is Increased

No. of Cars Per Cut	No. of Cuts	Total Direct Minutes a/	Direct Minutes per Cut	Direct Minutes per Car	Percent Average Eng. Mins. per car is of single car switch.
1	378.5	3031.33	8.009	8.009	100.0%
2	189.25	1691.06	8.936	4.468	55.79
3	126.17	1244.33	9.862	3.288	41.05
4	94.62	1020.89	10.789	2.697	33.67
5	75.70	886.90	11.716	2.343	29.25
6	63.08	797.52	12.643	2.107	26.31
7	54.07	733.71	13.570	1.938	24.20
8	47.31	685.84	14.497	1.812	22.62
Calgary					
Yd. Average					Saving
2.5346	149.33	1408.35	9.431	3.721	
Grain Loads					18.27%
3.3494	113.01	1151.13	10.186	3.041	

a/ Total Direct Minutes = .9268 x 378.5 + $\frac{2,680.54}{378.5}$ x No. of Cuts

= .350.79 + 7.082 x No. of Cuts.

What I did was to fit an equation of multiple regression methods to two independent variables which then permitted me to derive a scale which is shown on page 32 of the brief. Now, I might point out that this scale evidences savings in cuts per car which are twice the magnitude of the savings which are shown from Pooles data. These savings by reference to a tabulation on page 33 of the brief where we have first for flat yards, the summary of the two types of study showing that in general the Wright Scale is the more conservative as compared with the scale prepared by Meyer-Stenason Poole whereas in hump yards the Meyer-Stenason-Poole Scale from Poole data is more conservative than the scale on the Borts in the interest of conservatism we used smaller percentage savings and calculated an average percentage savings for the whole system which is described on page 37 of the brief.

C. The following table summarizes the estimates of percentage saving in direct time resulting from handling larger cuts of grain cars as opposed to handling cars in the average cut size experienced at the yard. The estimates are shown separately for flat yards and hump yards.

I. Flat Yards

Experience at:	Wright Scale	Meyer-Stenason-Poole Scale
Calgary	19.38%	24.29%
Saskatoon	9.54%	11.84%
Souris	31.20%	43.87%
Winnipeg CNR	28.08%	35.78%

II. Hump Yards

Experience at:	Meyer-Stenason-Poole Scale	Borts Scale for Calgary
Calgary	7.18%	18.27%

It can be seen that the estimated savings in flat yards correspond in magnitude to the differences in each yard between the average cut of all loads and the average cut of grain loads. It is also evident that the savings in the hump yard due to large size cuts are smaller than the savings in the flat yard. This is in accordance with engineering experience.

In applying these savings to the costs of handling grain traffic, we shall in the case of each type of yard use the most conservative estimate, even if it is an underestimate. We shall therefore apply the Meyer-Stenason-Poole Scale to hump yards and the Wright Scale to flat yards.

In order to determine the effect of these savings on the total engine minutes per car it is necessary to know the proportion of time which is overhead or unproductive. In addition, it is necessary to adopt a method for apportioning this unproductive or overhead time

over the engine time which varies directly with the output units.

In the Wright article, the author indicates that 808 minutes per day are overhead. In the sample there are approximately 2038 minutes per day of total engine time: This gives a ratio of 39.6% of time which is overhead, the remaining 60.4% being directly variable with traffic.

The Meyer-Stenason equation for flat yards indicates that at the mean, 41% of the total time is constant, the remaining 59% being variable with output.[1]

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1. In this study, the constant term in the regression equation is 3.067 minutes per block. The sample average is 7.448 minutes per block. The ratio of the constant to the sample average is 41%.

The Meyer-Stenason equation for hump yards indicates that at the mean 24% of total time is constant, the remaining 76% being variable with output.[2]

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2. In this study, the constant term in the regression equation is 1.962 minutes per block. The sample average is 8.214 minutes per block. The ratio of the constant to the sample average is 24%.

The equation derived from the Calgary data indicates that at the mean, constant time is 44% of the total, with the remaining 56% being variable.[3]

3. In the equation derived from the Calgary data, the constant term in the regression equation is 1091.05 minutes per shift. The calculated average minutes per shift is 2499.40. The ratio of the constant minutes to average minutes if 44%.

In commenting on the constant terms found in the flat yard and hump yard studies, Meyer and Stenason made the following statement (p.313)

> "One disturbing aspect of these functional relationships is the large size of the constant terms in both cases. It would be convenient to ascribe these constants to unproductive time, but such time has been excluded by definition from the data used in the analysis. Careful inspection of the data indicates that these constants are due to a substantial nonlinearity for the smaller blocks, and particularly for blocks involving a small number of cuts. This is true of both the hump and flat yard operations which is best substantiated by a quick perusal of the minute per cut column in both tables. The time consumed for cuts seems to drop sharply as the number of cuts per block of cars is increased."

It is clear from the quoted passage that the authors feel that constant time of 41% of the total or 24% of the total is unusually high. In applying the estimated savings to total yard time we shall assume that

40% of the flat yard time is overhead, while 24% of the hump yard time is overhead.

We shall also allocate the overhead time directly on a percentage basis to the direct or productive time.

The following savings therefore occur.

1. Flat Yards

Experience at:

	Calgary	Saskatoon	Souris	Winnipeg-CNR (a)
Yard Average Minutes Per Car	6.5486	5.4052	1.9936	5.4290
Direct Minutes Per Car: 60% of Total	3.9292	3.2431	1.1962	3.2574
Overhead Minutes Per Car: 40% of Total	2.6194	2.1621	.7974	2.1716
Reduction Due to Handling Grain Cuts	19.38%	9.54%	31.20%	28.08%
Saving in Direct Minutes Per Car	.7615	.3094	.3732	.9147
Saving in Overhead Minutes Per Car	.5076	.2063	.2488	.6098
Total Saving	1.2691	.5157	.6220	1.5245
% Reduction in Total Minutes Per Car	19.38%	9.54%	31.20%	28.08%

(a) In his cross-examination (p.13186) Mr. Bandeen indicated that a reduction of .38 minutes would reduce the classification engine minutes by 7%. Taking the ratio .38/.07 yiels 5.429 minutes as the yard average classification time per car at Winnipeg.

II. Hump Yards

Experience at Calgary

Yard Average Mins. Per Car	6.5486
Direct Mins. Per Car: 76% of Total	4.9769
Overhead Mins. Per Car: 24% of Total	1.5717
Reduction due to Handling Grain Cuts	7.18%
Saving in Direct Mins. Per Car	.3573
Saving in Overhead Mins. Per Car	.1128
Total Saving	.4701
% Reduction in Total Mins. Per Car	7.18%

D. On the basis of the savings shown above, we have constructed a weighted average saving in classification engine time in flat yards. This will be applied to the through load and empty cars of grain and grain products handled at certain of the CPR flat yards. We shall use the estimated saving of 19.38% on the basis of Calgary cut-size experience as a measure of the saving to be obtained at certain large size yards. We shall use the estimated saving of 9.54% on the basis of Saskatoon cut-size experience as a measure of the saving to be obtained at certain medium size yards. The saving of 31.20% on the basis of Souris experience will be taken as a measure of the saving in small yards. Each of three percentage savings will be weighted by the total number of grain and grain products through loads and empty cars handled at the yards of three sizes. This weighting system does not reflect the total through grain traffic, for certain of the yards will receive different types of

adjustments in our memorandum No. 2.

The large size yards include only the through cars at Moose Jaw (73,853). Calgary and Winnipeg are hump yards and will be treated separately. Fort William and Vancouver are largely destination yards where the classification of through grain cars may not be mixed in with the classification of other traffic. These yards are also excluded.

The medium size yards include total through cars of study traffic at Saskatoon, Medicine Hat, Regina, Edmonton, Lethbridge, Brandon, Cranbrook, Nelson, Penticton, and Swift Current. The number of cars was 226,608. We have excluded the following medium sized yards for a different treatment of classification switching: Kenora, Kamloops, Revelstoke, Field, Ignace, and Broadview.

The small yards include all through cars of study traffic in all A, B, and C yards, except North Bend. The total was 278,264 cars.

The weighted average results from the following computations:

	Percent Saving	No. of Cars	Weight	Weighted Percent
Large Yards	19.38%	73,853	.1276	2.47
Medium Yards	9.54%	226,608	.3916	3.74
Small Yards	31.20%	278,264	.4808	15.00
		578,725		21.21% Weighted Average

The average percentage saving consists of a weighted average percent where the weights consist of the number of cars handled in classification switching at large, medium and small yards that correspond to the total number of cars handled in this way because of certain adjustments which were imposed on the data that are described in memorandum No. 2. For instance, certain cars which the company classed had received classification switch, we do not.

We arrive at a weighted average percentage saving of 21.21% in flat yards. This is a conservative estimate of the saving in classification engine switching arising from the large size of cut in the grain traffic.

It is conservative for two reasons.

(a) We have understated the difference in the size of cut between grain and non-grain traffic. This arises from the inability to observe the cut-size applied to empty cars in the grain service. We have assumed for computation purposes that these empties experience the same cut size as through grain loads, when it is likely they actually experience a larger cut size.

(b) We have used the more conservative switching scale showing smaller economies in engine time. This is the Wright Scale. The scale developed by Meyer and Stenason indicates larger economies than those we have used.

E. We shall apply the more conservative scale to estimate savings from larger cut sizes at hump yards.

This means we apply a saving of 7.18% to classification engine time at the two hump yards in the grain service: at Calgary and Winnipeg.

Q. You do have the Calgary saving.

A. Going back to Page 32, my saving was 7.2%.

Q. But in the study you used the Poole scale of 7.18%?

A. That is right. I might explain why that was derived. It will be recalled that sometime last spring I believe the CPR introduced exhibit 132 in which there was an alteration in the method used to compute costs of all rail traffic and the constant cost which was filed applies to the railway grain traffic. Accordingly, I felt it desirable to specify clearly the old method and the new method which they used and indicate the apparent consequences of switching or shifting from one to the other. I might say in introduction that there are no a priori grounds which can be chosen in favour of one method or the other. There is a strong desire on the part of every financial officer to know where all the money went which I suspect overweighs the way in which the statistician goes about determining constant cost which was the heart of the original determination of constant cost which was in the first exhibit which the railway put in.

This is based on the observed experience at Calgary with regard to cut-size. Again this is a highly conservative estimate. The cut sizes for grain are very likely understated for the reasons given above.

In addition, the scale actually developed from the 12 observations on Calgary operations would lead to a saving in engine time which was more than double the saving we actually are using.

The Determination of Constant Costs

13. In their original exhibits, the CPR developed the constant costs of traffic directly from the regression equations. It will be recalled that each of the regression equations has a constant term which represents the portion of total cost which is not explained by the variation of the particular expenditure categories with the independent variables. For example, the general form of a simple linear regression line fitted to cost-output data is

$y = ax + b$, where y is cost, x is output.

If I could illustrate this on the blackboard I think it will help. This is track maintenance and this is gross ton miles, a straight linear regression line is fitted to the data and when the line is extended back to the vertical axis as I have drawn it there is a positive constant amount of cost which is not directly variable with gross ton miles. In determiming the total variable cost of this account the procedure which would be followed would be to say this is the total gross ton miles of the railway company and, therefore, this portion is the total variable cost. That is the portion between the constant and the straight line, the difference would represent the constant portion of that expenditures

account.

Now, this was the original basis upon which the company developed the constant cost on grain traffic.

Q. This was the first development?

A. This was the first development, yes.

Q. We can take that before exhibit 132?

A. Yes, I might say what they did for each cost equation which was determined by our regression relation, they took the constant for each equation and added it up and said for this group of accounts this is the constant costs for this group.

The coefficient a is the regression estimate of the unit cost coefficient, that is, the portion of cost which varies directly with output. The coefficient b is the constant term in the equation. The determination of constant cost for the system was made by adding up all the individual constant terms from each regression equation. To this was added any expense items which were not regarded as variable with traffic such as snow removal. This was automatically put into constant costs without any attempt at identification with a service unit.

This adding up procedure will not yield a term which allows reconciliation of total constant plus variable cost with the total railway costs for any particular year as reported to the Board of Transport Commissioners. There are at least two reasons for this:

First, the regression relations are derived from

three year averages of operating accounts - averaged over the years 1956, 1957 and 1958. The consequence is that the sum of constant plus variable costs for these regressions would equal the three year average of reported railway costs, not the costs for any particular year.

Second, the regression equations frequently ignored observations on five divisions of the CPR: the four terminal divisions and the electric division.

I would like to interpolate three other points which made reconciliation possible in addition to those two which I have already mentioned. Third was that there was a three yard average cost for grain doors in the original study which you meet, to reconcile account 402 in any particular year. Fourth, the weighted costs were based on 1958 but again reflect the constructed year of November, 1957 to October, 1958. Fifth, labour and material cost elements in the road and equipment maintenance accounts were not actually 1958 but were indexed up to reflect the cost of levels prevailing at December 31, 1958. While each of these adjustments have their own justification in the railway's presentation, they effectively interfere with a reconciliation of this sort.

The consequence is that the sum of constant and variable costs will not equal total reported costs. Even if allowance is made for the excluded divisions by adding their output units to total output, the reconciliation is not likely to be possible. The reason

is that the regression relations estimated from the 27 divisions may be poor or inadequate representations of the cost-output relations in the excluded divisions.

In an attempted reconcialiation of the sum of constant plus variable costs with reported expenditures, the CPR statisticians discovered that they could not explain all reported costs. As reported in their exhibit 132, their sum of constant plus variable fell short of total reported costs by a substantial sum.

This can only be inferred because I have not the data at hand and if my numbers are incorrect I will be very pleased to correct it later on.

The portion of this sum applicable to grain is $2,316,920. Using the calculated per cent of 15.306% as their ratio of grain variable to total freight variable costs, the amount of the shortfall was approximately 2,316,920: .15013 = $15,432,758.

Q. This data was not provided to you?

A. These are inferences made on the basis of rough percentages and they are probably not literally correct but I will be delighted to be corrected in this regard.

This is only an estimate as it does not take account of changes in constant cost coefficients resulting from their revised regression equations in exhibit 132. In any case it may indicate a serious lack of correspondence between the regression relations and the overall cost conditions in the system.

As I say, it is only an estimate and it does not take account of changes in cost coefficients resulting from their revised regression equation for shifting to this new basis except for the dictim that it must add up. As a result of this inability to reconcile the constant plus variable with the expenses reported to the Board of Transport Commissioners the railway statisticians chose a new method of arriving at constant costs, as costs the difference between the total expenses in a particular camp and the amount of expenses which was directly variable with traffic. If I could again illustrate on the board, what was done was to take this as variable ---

Q. Could you explain so it will be on the record.

A. If I could refer back to the original diagram underlying the portion of cost between variable and constant we would take this regression line.

Q. That is the sloping line?

A. Yes, the sloping line and read off the total costs for blocking in the total car ton mileage. You will recall originally this was split between a variable component and a constant component and I have gone through this description as to why it is variable plus this constant and it does not add up to anything which appears in a financial statement. The new method was to take the variable but not take the constant as shown in the regression equation but not to

continue constant as shown in the regression equation but to continue constant as the difference between the total shown in the financial statement and the direct reconciliation was possible back to the financial statement of the company.

As a result of this inability to reconcile the constant plus variable expenses with the expenses reported to the B.T.C. the railway's statisticians chose a new method of arriving at constant cost. They used as the constant the difference between the total system expenses in a particular account and the amount of expense which was directly variable with traffic. Summed up over all accounts, this provides an estimate of total constant costs which does permit a reconciliation.

There are no a priori grounds on which one can choose one method of determining system constant costs over the other. Nor is there any way of determining whether the CPR procedure in the revised exhibit was motivated by the effects it would have on their estimate of the overhead costs applied to the grain traffic. For these reasons, we have decided in our own development of constant costs to use both procedures. These will be embodied in exhibits underlying the second study which follows this study. The purpose of using both procedures is simply to illustrate the range of variation which is possible in attempting to allocate a share of the overhead to the grain traffic.

In conclusion it should be emphasized that the CPR has given unsatisfactory and inconsistent reasons for the change to the new method of allocating constant cost as embodied in exhibit 132. To quote from this exhibit,

"By developing System constant costs from the

constant in the regression equations, it was noted that proper weight was not given, because in some instances, the regression equation was based on the road divisions alone. That is the 27 divisions. A check also showed the variable cost plus constant costs fell short of railway operating expenses. Accordingly a new procedure was applied by which constant costs were derived from total railway operating expenses and variable cost, passenger, and freight."

Dr. Edwards explained this procedure in his testimony on redirect by Mr. Sinclair: Dr. Edwards said, p. 12,582: "the constant costs applicable to terminal divisions were omitted in the initial method and that the inclusion of these costs largely accounted for the final result."

In their original development of constant costs, it is not true that CPR failed to include an estimate of such costs for their 31 divisions. It is not true that the constant costs were omitted for the four terminal divisions. This estimate was made by adjusting the constant term in the regression to take account of the appropriate number of divisions. An example will demonstrate the procedure they adopted.

This example refers back to their original exhibits.

The original regresssion model for acct. 202

- Track Maintenance and Depreciation, shows a constant term of $1,157,869. Since the coefficients of the equation were estimated from a sample of 27 divisions, this constant is to be understood as the Track Maintenance and Depreciation expenses per division which are not related to the independent variables of the regression equation. Further, the data underlying the regression are three-year totals of output and expense units. Therefore the constant is a sum which refers to a three year period of railway operations.

In order to transform the constant so that it reflects a one-year period of operations, it must be divided by 3. In order to find the total constant cost for this account, the constant term must be summed over the relevant number of divisions. While it is true that 27 divisions formed the basis of the sample, there are 32 divisions operated by the railway, when one includes the four terminal divisions and the electric division. The CPR therefore adjusted the above constant term twice; it multiplied the term by 32 to reflect the total number of divisions, and divided the term by 3 to place it on a one year basis. The resulting adjustment yields a total constant cost for this account of $1,157,869 x 32/3 = $12,350,603. This figure is shown in Column 3 of the original CPR exhibit 411 (I do not know what this exhibit number is in this context) entitled Development of Constant Costs. The CPR have carried out a similar adjustment for every regression equation in the study which was fitted to a sample of divisions. In some

cases, where 10 districts were used in place of 27 divisions, the adjusting multiplicative factor is 10/3, rather than 32/3. In a number of cases, where three year totals of the data were not used the adjusting factor is not divided by 3. The adjustments described above are shown in the following table. The first column shows the regression constant as it was printed out in the original CPR computer regression program. In 3 cases, the new regressions of exhibit 132 are also shown. This information was copies from CPR records supplied to us. The second column shows the adjustment factor as described above. The third column shows the resulting constant cost figure as shown in column 3 of the original CPR exhibit.

It must be clear therefore, as I have shown in this table on page 43, that the original CPR exhibit did contain an allowance for the constant costs of the terminal divisions; it did not contain an allowance for the constant costs of the electrical divisions. Whatever the reason for changing this part of the exhibit, it is not for omission of these costs.

If I end on a point of mystery it is because I do not know why the exhibit was changed.

Q. You say they did not include ---

A. They included an estimate for them.

Q. This 32/3?

A. Right.

Q. That exhibit number that you mentioned on page 42 is exhibit 69 in the proceedings before this Commission.

CPR Development of System Constant Costs
(Columns 1 and 3 in dollars)

Account	(1) Regression Constant	(2) Adjustment Factor	(3) Constant Cost
201, etc.	101,939	32/3	1,087,349
202, etc.	1,157,869)old	32/3	12,350,603) old
	1,208,385)new	32/3	12,889,440) new
221	56,678	32/3	604,565
227	31,437	32/3	335,328
231	26,722	32/3	285,035
235	50,568)old	10/3	168,560) old
	24,360)new	10/3	81,200) new
270	no regression - allocated		158,963
272	no regression - allocated		3.519,435
301	38,052	10	380,520
326	time series regression		343,092
331	no regression - allocated		130,015
371	123,820	32/3	1,320,747
372-3-6	624,995	32/3	6,666,613
377	62,795	32/3	669,813
386	3,639	10/3	12,130
398-400	108,987)old	10	1,089,870) old
	161,051)new		1,610,510) new
405-406	no regression - allocated		418,378
Investment Road Property	34,125,798	32/3	364,008,512

The Cost to the Canadian Pacific Railway of Moving Grain to Export Positions in Western Canada

Addendum to Memorandum No. 1 on behalf of The Governments of Manitoba and Alberta

General Comments

1. The governments of Manitoba and Alberta are submitting esti ates of the cost to the Canadian Pacific Railway of handling Crow's Nest grain. It was originally intended to present the statistical methods underlying these estimates in two studies, but it has now been decided to add a third study, so that adequate emphasis may be given to an important element upon which our cost estimates are founded. The study added to those described in Memorandum No. 1 will concern itself with permissive earnings upon railway investment.

2. Account No. 202, etc. - Track Maintenance and Depreciation.

At pp. 4-7 of Memorandum No. 1 we analyzed the CPR regression model which attempts to explain expenses in this group. We presented a corrected model which revealed that track maintenance cost attributed by CPR to track mileage is actually explained in part by the terrain which the railway traverses. Memorandum No. 1 further indicated that we proposed to adjust a variable (miles of track per dollar of investment in Tunnels, Bridges and Culverts) in our equation to accord with experienced track maintenance requirements in the United States.

Subsequent to submission of Memorandum No. 1,

we reviewed the explanation of Track Maintenance and Depreciation provided by Equation 202A (p. 4, op.cit.) and concluded that another specification could be devised which would improve upon that equation.

The new model makes use of an explanatory variable not previously tested in this connection, namely train-miles. Data for this output unit are available on a divisional basis (exclusive of terminal divisions), and when adjusted to reflect the size related track maintenance and depreciation expense estimated in Memorandum No. 2, the resulting equation is:

202C

	Variables	Value of Coefficients	Standard Error	Value of T
1.	Constant	$1,319,000	$885,100	1.41
2.	Investment in Tunnels, Bridges and Culverts	0.05745	.02312	2.48
3.	Train Miles	0.3896	.0698	5.58

The value of R^2 with 27 observations was 0.6942.

The dependent variable for this equation is Acct. 202/266 Track Maintenance and Depreciation minus $742.52 x Miles of Track.

Now, Dr. Borts, I just want to deal with one or two matters and expand this precis.

With reference to those equations 202A, B and C, I take it from your advancing the model which attributes a certain amount of track maintenance expense to the geographic nature of operations -- and that is what it does, does it not -- that the CPR model failed to give, in your opinion, proper effect to this variable item?

A. I would say what the CPR model did was to impute or allocate some of the effects of geography to the other variables which they have. In our opinion, therefore, they overstated the proper allocation of cost to the output and track bearings.

Q. As I understand the models that you have utilized and found satisfactory, you found there was very little correlation in western Canada between gross ton miles and track maintenance expense, while there was a marked degree of variability in eastern Canada?

A. Yes; you are repeating what I have on page 3.

Q. That is the correct interpretation of that?

A. Very little correlation between track maintenance and gross ton miles in the west, and much more in the east.

Q. All the equations, I understand, make

corrections?

A. Yes; I should explain what the other equations do. In each case where I felt dissatisfied with the statistical significance of the equations which the CPR presented, or the statistical meaning of the equation, I fitted an alternative equation to it. I should distinguish clearly between "significance" and "meaning". In my memorandum I have a discussion of the dissatisfaction which I feel with certain of the CPR equations where the so-called T test indicates that the numerical values of the co-efficients are no better than well-informed guesses. I have tried in those cases to substitute an equation which is statistically significant. At the same time, with the equation, I have tried to substitute allocations to expense account to a service unit. In other cases there is the question of the statistical meaning of the equation, because I have felt and expressed in the memorandum that the CPR equation represents not an allocation to a service unit but simply a proration among all of the accounts of the system, and I feel proration is something that should be avoided if it is possible to identify an account with a service unit, because proration in this sense is a concession of despair, that an allocation to a service unit is not possible.

Q. I just want to deal with one or two to illustrate this, since we do not want to read the complete precis. In the account of shop engine houses, maintenance depreciation, as I understand your new

equation ---

A. The equation which I used for western Canada is shown at the bottom of page 8 and that allocates that maintenance account to yard and train switching miles.

Q. And also account 253?

A. Yes, that is the equation for the maintenance and depreciation on power plant which in my relations is for western Canada, again, and is allocated to yard and train switching miles.

Q. On page 9 I note in reference to this equation covering accounts 253, 266, you remark this is an example of a situation where the CPR attempts to use a factor which is variable in the east to explain variable costs in the west.

A. No, it is an example of their use of the relation which holds in the east to explain variability in the west -- yes.

Q. And you have made a correction?

A. I tried to make a correction for that, yes.

Q. On page 11 you point with reference to accounts 372, 373 and 376 -- you point out two of the output variables, namely, passenger car miles and carloads have coefficients not significantly different from zero?

A. Yes, that is correct. This means that the coefficient which the CPR used should be replaced by an informed guess because you cannot attach any

statistical significance to it.

Q. And this business of "statistical significance" on various levels, as I understand your approach to it, and in your taking the 5% level as the proper level, the danger in taking something excepting figures above this level would be, in your opinion, the danger of allocating to grain, in this case, costs that are not truly variable with grain.

A. Which may not be truly variable with grain.

Q. On page 18 you have utilized in your study both gross ton miles and car miles?

A. No. Do you want me to explain briefly the import of this section?

Q. Yes, if you can make it a brief explanation.

A. In a brief explanation, the railway made very extensive use of gross ton miles as an independent variable in its regression equations, and it struck me as a curiosity in view of the fact grain is a heavy loading traffic why they should use a variable which would emphasize the weight of grain where there are economies from loading grain which did not appear in this formulation which they presented. So, I attempted to make a calculation in which I substituted car miles for gross ton miles to see what effect this would have on the costs which would be attributable to grain. The calculation which I carried out revealed that the variable costs attributable to grain would be reduced by

some $1,300,000. If you substitute car miles for gross ton miles and thereby take account of the fact that a ton or 100 tons of grain requires fewer cars, in terms of average experience, than 100 tons of some other commodity which does not get loaded as heavily. This is the import of this section.

I may add, while we made this calculation of a saving of $1,300,000, we did not carry this into our constructive estimate of costs, again in the interests of conservatism.

Q. Do you know whether it would change the other regressions?

A. Well, I made a check on this by seeking what the relationship was between car miles and gross ton miles, and it appears it would not change the regression. So, this calculation would hold firm.

--- A luncheon adjournment ---

--- On resuming at 2 p.m.

THE CHAIRMAN: Order, please.

MR. MAURO: Before Mr. Banks is called, my learned friend Mr. Sinclair asked one or two questions this morning. One concerned yards of these other studies conducted by Mr. Wright and Mr. Poole. I think Mr. Sinclair's question ---

THE CHAIRMAN: It can be answered now?

MR. MAURO: Oh yes. We have some information now.

Q. Dr. Borts, would you place it on the record now?

A. Yes, Mr. Mauro.

Mr. Sinclair asked me three questions, and I would like to put them on the record. One is whether -- on page 21 of my memorandum -- whether the average cut sizes for grain loads, all loads, and all loads and empties did or did not reflect yard transfers as well as cars coming in on incoming trains. The answer is that these figures represent cuts only on cars coming in on incoming trains. There are no cars coming in on what you call your transfers.

Now, the next question referred to two studies which I quoted in my memorandum one by E.C. Poole, and one by Wright.

Q. This is at page number ---

A. This is -- well, I do not think there is any page reference, now.

Q. Then, it is on that portion on multiple switching?

A. Yes, on that portion referring to multiple car cuts.

First of all, the question was asked did the Poole Scale for hump yards refer to mechanical or manual humps and the answer -- I am quoting now from the article which we will make available to the Commission, and which is available publicly -- the article by Poole which Meyer and Stenason used. It is a paper presented to the Pan-American Congress in 1953.

Poole refers to a rider hump yard, and I can quote from this. Where he is referring to data, Poole says:

"Appendix 'C' shows the observed time actually spent distributing 403 cars over a rider hump yard".

That is the answer to your second question, Mr. Sinclair.

The answer to your third question -- it was how many yards were observed in each of the Wright and Poole studies. The answer unequivocally in the case of the Wright study is that he did it for one flat yard and the answer in the case of the Poole study is that we do not know because Poole refers in one place to yard and in another to yards, and it is not clear from the article.

Q. We will make these studies available to the Commission's staff?

A. Yes, we will.

MR. MAURO: I think those are the questions, Mr. Sinclair.

Thank you very much, Dr. Borts.

THE CHAIRMAN: Is that all, Mr. Sinclair?

MR. SINCLAIR: All the questions I have? By no means, Mr. Chairman, but at this time, it is.

MR. MAURO: Those are questions which Mr. Sinclair placed on the record this morning.

THE CHAIRMAN: Yes, we realize that.

Mr. Frawley?

MR. FRAWLEY: The next witness is Robert L. Banks.

ROBERT L. BANKS, called

DIRECT EXAMINATION BY MR. FRAWLEY:

Q. Mr. Banks, you live in Washington where you carry on your profession as a transportation consultant?

A. That is correct, Mr. Frawley.

Q. If you will please attend while I read these biographical notes, Mr. Banks, and when I am finished you can agree with it.

Robert L. Banks is a 1939 graduate of Columbia College in New York city. He was Fellow in Transportation at the Yale University Graduate School during 1939-40, from which he received the Certificate in Transportation. In the fall of 1940, Mr. Banks joined the New York Central System's Passenger Traffic Department, where he was assigned to various positions in New York and Albany. In early 1942, Mr. Banks enlisted in the Army of the United States, from which he was discharged fifty months later as a Major of Artillery. Mr. Banks rejoined the New York Central in 1946, and participated in railroad's sales and service activities, until 1949, when he left the railroad and entered the Federal government service in Washington, D.C. With the government he was employed successively as Chief of the Transport Service Section of the Civil Aeronautics Board, as an industrial analyst in Transportation with Headquarters, United States Air Force, and as an employee of the Central Intelligence Agency.

In 1956, Mr. Banks left the government service, and established his own practice as a consulting transportation economist. He has, subsequently, prepared many analyses and reports related to issues in air, rail, water, and highway transportation. His firm, R.L. Banks & Associates, is currently engaged in advising carriers, shippers, and governmental agencies on practical policy solutions to their transportation problems. Mr. Banks has prepared and presented testimony to the Interstate Commerce Commission Civil Aeronautics Board and various state regulatory bodies in the United States. He holds memberships in the American Society of Traffic and Transportation. The American Economics Association, and The American Association of Railroad Superintendents. He is also an associate of the Highway Research Board of the (U.S.) National Academy of Science.

A. That is correct, Mr. Frawley.

Q. Mr. Banks, you are asked by the governments of Manitoba and Alberta to examine the cost studies on moving grain to export positions in western Canada which were presented by the railways to this Commission. You were asked to do that?

A. Yes, sir, I was.

Q. And in the discharge of that commitment you prepared a memorandum upon the subject?

A. Yes, I did.

Q. And that memorandum you have with you now which is described only as "Memorandum No. 2 on

[illegible]

behalf of the governments of Manitoba and Alberta", and the caption being "The Cost to the Canadian Pacific Railway of moving grain to export positions in western Canada".

... (The following is the full text of the precis submitted by the witness).

THE COST TO THE CANADIAN PACIFIC RAILWAY OF MOVING GRAIN TO EXPORT POSITIONS IN WESTERN CANADA

Memorandum No. 2 on behalf of the Governments of Manitoba and Alberta

A. General Comments

1. By three memoranda, of which this is the second, the governments of Manitoba and Alberta are presenting their estimates of the cost to the Canadian Pacific Railway of handling Crow's Nest Grain. The previous memorandum described a study which evaluated and corrected certain of the regression model presented by the railway, and advanced estimates pertinent to the economics of multiple car cuts in classification switching. The study here described assesses and evaluates the work units applicable to grain, synthesizes these with the regression coefficients of the railway as corrected, and presents appropriate allocations of variable and constant costs. Finally, comparisons are made between the estimated costs of carrying grain and the revenues received by the railway from this traffic. The memorandum which follows concerns itself with permissive earnings upon railway investment.

2. Dr. Edwards has stated (a) that the grain movement "uniquely lends itself to costing" and (b) that the nature and characteristics of this traffic "have been utilized effectively to provide a most satisfactory identification of costs with the study traffic."[1]

It should be clearly understood that the "unique" fitness of the grain traffic for cost analysis is relative. Many costs attaching to grain can be more readily identified than those of other commodities moving in smaller volumes over less clearly defined routes. This cannot, however, be

interpreted to mean that costs incurred by this large and complex movement of railway traffic can be quantified with the absolute precision which is customary in the physical sciences.

Since railways are essentially a multi-product industry, characterized by the pervading presence of costs incurred in common for various types and classes of traffic and services, it is impossible directly to assign many categories of such commonly-incurred expenses. Thus the realistic objective of railway costing is to establish a reasonable identification between traffic and costs. Grain lends itself to this objective, but despite the volume at which it moves the resulting costs cannot be absolutely identified due to the inherent physical nature of railway technology and the multiplicity of assignments which a railway is called upon to undertake in discharge of its public service obligations.

The second quotation from Dr. Edwards bears directly upon the study described in this memorandum, by which it will be shown that the railway has not attained a satisfactory identification of costs with the grain traffic.

The intent of Manitoba and Alberta is to advance estimates which refine those submitted by the railway. To carry out this intention in a reasonable way manifestly precluded a complete examination of the railway's accounts[2]; by the same token it did not entail an investigation of each and every change made by the railway to meet the questions posed during the Manitoba/Alberta study, which would have required a continuing examination beyond that sufficient to establish that the railway's own cost analysis substantially overstates the costs incurred by the movement of grain to export positions during 1958. Our study indicates that if such a continuing

examination were to be undertaken, it would confirm the fact that the Manitoba/Alberta cost estimates are conservatively constructed. Research which illuminated additional areas, as to which no adjustments have been made, would very likely disclose further overstatements of the costs attributed by the railway to grain. These areas of probably overstated cost are further described in Part E, below.

3. In accordance with the approach outlined in the preceding section, the Manitoba/Alberta cost estimates relate in part to the original railway cost estimates, and in part to the revisions introduced by Exhibit 132. Appropriate comment is provided where, despite revision, the original cost estimates have been retained.

B. Restatement of Revenues

The railway presentation credits grain traffic moving at statutory and related rates to export positions with revenues totaling $35,402,790. This exceeds the amount which can be rightfully attributed to such traffic by $502,836.

I am advised that the rates and charges collected by the railway for extra service required on grain milled-in-transit are not set by statute, and as a consequence are improperly included in a study designed to compare revenues with costs of grain traffic moving at rates so fixed. Accordingly, the 1958 revenue credited to the study traffic by Manitoba/Alberta has been diminished by the amounts collected pursuant to such rates and charges, namely $456,000.

In Exhibit 132, an amount of $48,024, described as "local demurrage on grain products," was also credited by the railway to the statutory grain traffic. Insofar as can be determined, only $1,188 of this total accrued

at grain origin stations, the balance being further revenue generated by milling-in-transit service, and thus excluded from our study by its terms.

The CPR 1958 revenues creditable to grain and grain products moving at statutory and related rates to export positions in Western Canada are therefore appropriately restated as follows:

Revenues per CPR			$35,402,790
Local Demurrage	$48,024		
Grain Origin Demurrage	1,188		
		46,836	
Milling-in-transit		456,000	502,836
Revenues per Manitoba/Alberta			$34,899,954

C. Variable Cost Factors

1. Milling-in-Transit

Consistent with the revenue exclusion described and evaluated in Part B, the switching time associable with milling-in-transit service was identified and removed from the totals upon which our cost estimates are founded. The switch engine miles attributable to inbound movements of grain to mills, and outbound movements of grain products at all milling points totaled 123,893. When adjusted to include a pro-rated share of the service performed for non-revenue freight, this switch engine mileage was associated with $634,918 of cost as computed by CPR, or $538,337 as computed by Manitoba/Alberta.

2. Road Maintenance Expense

Regression model 202C described in Manitoba/Alberta Memorandum No. 1 yields estimates of Track Maintenance and Depreciation expense associated with terrain and road-haul transportation. This model does not explain

size - related road maintenance and depreciation expense since statistical analysis of these costs, by both the CPR and Manitoba/Alberta, produced track-mile costs at variance with actual engineering experience as to irreducible or constant track maintenance expense disclosed by extensive investigation of branch line data in the United States.

Accordingly, our estimate of road maintenance is a composite of regression analysis, as specified by model 202C, and engineering information, as described below.

The size-related cost, which was deducted on a divisional basis from the observations analyzed by regression methods, reflects a magnitude acceptable on an engineering basis, using data publicly available from the Dominion Bureau of Statistics, as well as information supplied by the CPR Engineer of Track. This cost is our estimate of irreducible road maintenance and depreciation expense. It includes provision for tie replacement, bridge and building labor and material, fences, snowsheds and signs maintenance and depreciation, weed control and superintendence, plus an allowance for contingencies. It excludes costs of rail replacement which, at minimal maintenance standards under the most favorable conditions, is governed by action of the elements rather than by any necessity fixed by the requirements of traffic. In this respect ties differ materially from rail, since the effect of weather upon the former is substantial, but upon the latter is so much less severe that no basis exists for measuring the full life of little used rail material - even when this was installed in the Nineteenth Century. In other words, engineering experience has not, to our knowledge, assessed the serviceable life of steel rail on a branch line maintained in the absence of traffic. Thus rail replacement is irrelevant to any estimate of irreducible maintenance expense.

We conclude, on these bases, that a reasonable estimate of irreducible size-related track maintenance and depreciation costs, at 1958 price levels, is $947.46, of which $742.52 is the basic unit cost of road maintenance and depreciation per mile of track. The CPR, by contrast, has comparable estimates of $1,379.78 and $1,136.81, results apparently obtained by attribution to size of costs actually generated by output or geography.

Through adjustment in this manner of our road maintenance and depreciation cost estimates to reflect engineering experience, we have increased the variable portion of these costs, i.e., those attributed to the "substantially related" lines, by $938,292 in excess of the expense derived from reliance upon regression model 202A. Despite this substantial cost increment induced by departure from statistically significant results, we believe this adjustment is warranted by the essential requirement that an approach to improved accuracy can be attained only if all elements of variable cost attaching to grain are fully identified. A measure of the difference between full cost identification and excessive cost attribution is provided by the $1,346,625 difference between our estimate of substantially related road maintenance and depreciation and that computed by the CPR.

Although model 202C does not explain by regression analysis the variable portion of road maintenance cost incurred by switching service, this can nevertheless be isolated by reference to available data. The 27 divisions analyzed by that model exclude the four terminal divisions at Montreal, Winnipeg, Toronto and Fort William. For these divisions, Manitoba and Alberta have constructed an equation, using the previously discussed size-related expense, to explain the unit variable cost of road maintenance expense attaching to switching service, as follows:

$$\text{Road M\&D} = \$742.52 \times \text{Track Miles} + \left[\frac{\$5,755,453}{13,119,886 \text{ Yd. Swg. Miles}}\right]$$

$$\times \text{ Terminal division Yard Switching Miles}$$

The expense explained by this equation was adjusted to normalize the depreciation charged against (a) Roadway Machinery and (b) Public Improvements, on the Winnipeg Terminal Division, as to which significant distortions are revealed by comparison of 1958 reported expense with (i) other divisions and (ii) other years on the same division. The unit variable cost of road maintenance and depreciation per switching mile derived in this manner was deducted from the constant portion of model 202C, and charged to the handling of grain in proportion to the output units appropriately attributable to that traffic.

The basic principle involved in reconciling regression results with engineering information is not novel. It has been previously used elsewhere and described as follows:

> Essentially, this procedure involves allocating or identifying the deficiency or excess in the regression estimate ... with existing or hypothesized independent variables on the basis of outside information about the system or cost structure being analyzed.[3]

3. Car-Day Count

The repair, depreciation and earnings expense incurred by freight cars in grain service is an extremely important part of total study traffic cost. By the original railway estimate, these costs, and those derived from or associated with them, amounted to $15,190,283; as revised by Exhibit 132, these totaled $14,638,846.

Two output units are determinative of these costs: car-miles and car-days. In its original cost estimate, the CPR determined study traffic car-miles to be 213,831,793; this estimate remains unaltered. Car-days, however,

originally estimated by Exhibit 64 at 3,385,910, are given as 5,274,358 in Revised Exhibit 64, an increase of 55.8 percent.

This major modification in a fundamental measure of output illustrates the arbitrary statistical mechanics necessarily involved in the derivation of car-days devoted to hauling a commodity, such as grain, which is carried in cars interchangeably devoted to the service of other traffic.

The CPR working papers underlying original Exhibit 64 showed that two quite different and inconsistent methods have been used by the railway to compute car-days. One method was used for the CPR System as a whole, and another for grain. It was necessary to develop a system total with which to compare grain so that a portion of repair and depreciation expense, and of earnings expense, recorded only on a system-wide basis, could be apportioned to grain. Our analysis determined that if the car-day method used for grain was applied to the system, it would more than double system car-days. If the system method were to be applied to grain, it would reduce grain car-days by more than half. In either case the result was the same: a discrepancy exceeding 100 percent in the number of car-days assigned to grain. This discrepancy becomes apparent by inspection of the following table, which excludes adjustments due to non-revenue freight.

Active Car-Days
By CPR Original Method

Item	Source	Method	Result
(1) Grain Car-Days	Exhibit 64	3700 Car Sample	3,257,123
(2) System Car-Days	CPR Workpapers	Rail Form "A"	14,828,817
(3) Ratio: Grain to System		(1) ÷ (2)	.21965
(4) Grain Car-Days	Computed	Rail Form "A"	1,470,604
(5) Ratio: Grain to System		(4) ÷ (2)	.09917
(6) System Car-Days		(1) ÷ (5)	32,843,834
(7) Ratio: Grain to Grain		(4) ÷ (1)	.4515
(8) Ratio: System to System		(2) ÷ (6)	.4515

Lines (1) and (2) are the data originally used by CPR. Line (4) is the number of active car-days attributable to grain using the method employed for derivation of system active car-days, and Line (6) is the number of system active car-days derived by use of the method employed for grain.

In assessing the preceding table, and our conclusion that it suggests an appropriate decrease in the number of car-days charged to grain, it is important to stress that the data shown are described as active car-days, defined as "all the time the cars were under load plus the time of the related prior empty movement. All storage and repair times have been excluded from active car days."[4] This definition accords with that formulated by the Cost Finding Section of the Interstate Commerce Commission, which is as follows:

> The active car-days represent the time which can be specifically charged to a given revenue movement. It includes the switching time and the running time for the loaded movement plus the switching time and running time consumed in empty movements attributable to such loaded movement. It also includes, of course, time spent in loading and unloading the car. It does not include the non-active car-days, i.e., time consumed in car-days not directly traceable to a given revenue movement such as holding cars in yards for potential loading, seasonal storage of cars or time in repair shops (bad order). None of this time can be charged to any given movement. However, by dividing the total time-portion of the freight-train car expenses by the active car-days, the expenses chargeable to the non-active car-days are automatically distributed as an overhead cost.[5]

The foregoing text has shaped the understanding of active car-days and car-day development which is generally employed in rail cost analysis in the United States, by regulatory bodies, shippers and carriers. Thus the CPR in the first instance, chose to adhere to a well-known service or output unit - the active car-day - in its development of study traffic cost estimates.

By its revised estimates submitted with Exhibit 132, however, the railway elected to depart from established practice and to employ a freight car time measurement unit which in its workpapers is designated as a "calendar car-day." In explanation of this, we have been told only "that because of the way grain was handled, this cost should be broken down to cover costs variable with inspections, car days or car miles. This was done by excluding inspection costs amounting to 16% of total repair costs, and developing car days through a special sample of Canadian Pacific cars to determine the idle ratio."[6] Due to its departure from accepted concepts and established practice as to car-days, we believe that the burden of proof is on the CPR to justify its untested car-day calculation method, which it has not done in the data furnished us.

From the single page of explanatory data made available to us, it appears that the key element in the computation of calendar car-days charged to grain by the revised CPR estimate is the development of an idle ratio, i.e., a method by which freight car time not directly traceable to grain can nonetheless be attributed to it. This idle ratio amounts to 58.14 percent. As a result, by the new CPR method freight cars in grain service are apportioned in excess of one-half a day of time unrelated to that service for each 24 hour period directly traceable to it.

The idle ratio is derived and applied as follows, excluding on company service adjustment:

	Calendar Car-Days	
	Per Sample	Adjusted
1. Off-Line	76.41	84.90 a/
2. CPR Active	177.12	177.12
3. CPR Idle	111.47	102.98 b/

Idle Ratio = $\frac{102.98}{177.12}$ = 58.14 percent

Active car days study traffic	3,208,386
Active car days plus idle ratio	5,073,742

a/ Increment for off-line portion of "non-productive days"
b/ Reduction corresponding to a/

In our opinion, this method has several weaknesses which suggest that it, like its predecessor, may overstate car-days chargeable to grain. These weaknesses are:

a) The separation of CPR from off-line car days can induce distortions. Ignoring for the moment infirmities apparent in the numbers themselves, such separation has no equivalent in the freight car depreciation and earnings accounts of the company nor in the underlying unit cost computations computed for this study. It also conceals the probability that most CPR off-line car-days are accumulated by box-cars used interchangeably for grain and other traffic. Such interchangeability means that grain box-cars when in off-line service, for grain or other commodities, are contributing, by per diem earnings, to the revenues of the company. By contrast, one must infer from the method described above that study traffic box-cars, when not devoted to the movement of grain at statutory rates, are necessarily idle. This obviously is not so.

b) The divorcement of off from on-line car-days, and the apportionment by CPR of idle time entirely to on-line active days, ignores the fact that on-line idle time arises from off-line as well as on-line operating requirements and traffic opportunities. Consequently, the derivation and application of an idle ratio based solely upon on-line time is erroneous. Assuming, without conceding, the validity of the revised CPR method in all other respects, a closer approximation to the governing factual situation would be attained, in our judgment, by distribution of on-line idle time among total active car-days. Were this to be done, the idle ratio would decrease from 58.14 to 39.30 percent, as follows:

Per CPR	$\frac{102.98}{177.12}$	=	58.14
Restated	$\frac{102.98}{262.02}$	=	39.30

c) The sample from which the data are computed has been described only as "determined from a sample of freight cars traced for a one year period."[7] If this means a CPR freight car sample, rather than a box car or grain box car sample it must necessarily include specialized equipment devoted to the movement of commodities with traffic seasonality quite different from that of grain, such as ores and forest products. Such equipment would have idle characteristics markedly at variance with the boxcars in grain service, which can more readily be shifted to other assignments when not required for grain. Thus a system idle ratio, properly derived, must give substantial weight to the car service requirements of commodities with little or no similarity to the study traffic. By the CPR's revised method, however, the arbitrary separation between on and off-line car days imputes to grain the idle time characteristics of other than boxcar equipment, but withholds from grain boxcars the more favorable car-day count which would result if their active car-days in off-line service were to be considered.

d) An apparent increase in off-line time to provide for cars out of service, but lack of a corresponding on-line adjustment.

e) The ratio of idle to active car-days in the small sample as to which we have records of movement in revenue grain service, equalled only 5.5 percent.

f) A check of the small sample available to us indicates that clerical error failed to exclude all days properly designated as "idle" from the computation of active grain car-days. Accordingly, the 3,208,386 basic count of grain car-days may be correspondingly inflated by the inclusion of some idle days.

For these reasons we believe that the "calendar" car-day method used by the railway in its revised exhibits may yield results similar to the original method it superseded; it may overstate the number of car-days charged to statutory grain traffic. A more complete appraisal would require elaborate investigations of grain box-car idle patterns, non-productive time, and off-line characteristics.

It must be reiterated that all known methods of car-day counting require resort to statistical mechanics. None can measure direct or apportioned car-days with complete accuracy. All known methods require compromise with an unwieldy group of data, a compromise which entails some arbitrariness. In the absence of fuller information, Manitoba/Alberta chose to retain the count arrived at by the most generally accepted method. Therefore our analysis is based upon the original car cost pattern presented by the CPR.

4. Freight Car Repairs

By Exhibit 132, the CPR made fundamental changes in the method by which it estimated freight car costs attaching to grain. Originally, all expense in Account 314, less special maintenance costs incurred by refrigerator cars, was apportioned between car-miles and car-days on a 7:3 ratio. This follows I. C. C. costing methods.

In its subsequent revisions, however, the railway apportioned all freight car costs (less special refrigerator expense) on three bases:

Inspection Expense	16.0%
Car-Mile Expense	58.8%
Car-Day Expense	25.2%

The car-day count has been previously described, as has the CPR's explanation of its exclusion from the car-mile and car-day apportionment of the 16 percent of total repair costs attributed to inspection time. Additionally, the railway has said:

> The unit cost for the car-miles portion of repair and depreciation expenses was developed on the basis of car miles of CPR cars both on line and off line, to reflect the fact that the study traffic is not handled in foreign cars. As a result no adjustment on inter-line per diem charges is appropriate...[8]

We find this basis for the development of freight car repair and other costs open to question, for the following reasons:

a) The 16 percent of total freight car repair expense designated as inspection costs is apparently based upon a special study made by the U. S. rail carriers in I. C. C. Docket 31358, _C.B. & Q., et al. vs. N. Y. S. & W., et al.,_ as cited in Footnote 2, Schedule A, Sheet 1 of

Rail Form "A". The 16 percent figure can hardly lead to accuracy in cost estimation for the study traffic because it

(i) includes inspection costs of privately owned cars, for which no adjustment has been made by CPR;

(ii) is a U.S. average figure, hence unrepresentative of Canadian operations in which far fewer interchanges occur; and

(iii) is based upon data originally collected in the year 1947.

b) We know of no method by which car-miles of CPR cars in off-line service can be accurately determined without the imposition by CPR of an extensive burden on other carriers. We therefore believe that unit costs based on CPR freight car-miles "everywhere" are inherently inaccurate. (This, incidentally, is another reason why "active" car-days are to be preferred to "calendar" car-days. With the former it is unnecessary to rely upon or to compute such data as off-line car-miles.)

c) Since the car-day count determines a portion of unit repair costs, and since the CPR's revised car-day count is open to question, it follows that unit repair expense must likewise be open to question.

d) We find erroneous the denial of credit to study traffic cars for freight car hire accrued by such cars in off-line service. It is true that the study traffic was not handled in foreign cars during 1958. But it is equally true that CPR grain boxcars do move over foreign lines, and that in such service they contribute what may be a major share of the $14,859,188 in revenue earned by the railway in this manner during 1958.

As a consequence of the previously described car count method, the study traffic would be denied by CPR the beneficial results in time of using grain box cars for other purposes when not required for the movement of grain. As a consequence of the per diem exclusion, the study traffic is denied the beneficial results in money which accrue from the use of grain boxcars for other purposes when not required for the movement of grain. In short, Manitoba/Alberta find that, by CPR's revised costing methods, statutory grain is being asked to bear a disproportionate share of total freight car costs, while simultaneously denied an appropriate share of total freight car earnings. Accordingly, we believe that it is improper to disallow to grain, as the railway has done, its proportionate share of CPR's net freight car hire credit, when grain cars are used interchangeably for other movements.

The foregoing considerations impel us to conclude that the original method by which CPR calculated its freight car repair costs, adjusted to eliminate excessive service units, will yield a more accurate determination of actual expense.

5. Freight Car Depreciation

As an element of Maintenance of Equipment Expense, freight car depreciation is treated by CPR as having 100 percent long term variability with traffic. [9] Dr. Edwards has held that "the number of cars required over any period of time is closely geared to the volume of business handled." [10] This implies that as traffic increases more cars are needed. However, if the miles per car are increased in response to increasing traffic, this in itself may obviate the need for more cars, and thus negate the theory that car ownership, and hence depreciation, is variable with traffic. In response to our inquiry as to the support for Dr. Edwards' assumption, we were advised only that:

> Treatment of 100% variability is based upon a great many considerations including some mathematical analysis, the way in which repairs are carried out, the treatment of time as reflected in the cost study, and other factors.11

As far as could be determined, the mathematical analysis did not encompass the variability of freight car depreciation, and we do not understand the remainder of this statement.

Accordingly, we have conducted our own analysis of freight car depreciation, the results of which are illustrated by Charts I and II. Chart I correlates traffic with intensity of use; Chart II correlates traffic with owned car supply. Both charts show the experience of the CPR over the 35 year period 1924-58, which is proximate to the life of an average freight car. In both charts also, traffic volume is measured in terms of millions of loaded freight car-miles. In Chart I this freight car traffic index is related, by means of observations for each individual year, to intensity of use as measured in thousands of loaded car-miles per car owned. The resulting pattern and trend indicate that the loaded car-miles per car are highly variable with changes in traffic volume. If this is true, how can car ownership be related to changes in traffic volume?

In Chart II, the freight car traffic index is related in a like manner to the owned car supply as measured in thousands of calendar freight car days. The number of calendar car days is of course, determined by the size of the CPR freight car fleet as this varied from year to year over the period measured. Unlike the use pattern, however, the car-day or ownership pattern of the CPR freight car fleet does not appear to be directly or positively related to traffic volume fluctuations. In fact, Chart II

demonstrates how poor a correlation exists between car ownership and traffic volume. It would appear to contradict Dr. Edwards' statement as to a "close gearing" between car requirements and volume of business handled.

This analysis shows that the long-term traffic growth experienced by the CPR over a 35 year period was unaccompanied by a rise in freight car ownership. On the contrary, when the period is viewed as a whole, it must be concluded that a substantial increase in annual traffic volumes was experienced during a period when the long-term trend was to shrinkage of the fleet - to a decrease in freight car ownership. Increased traffic volumes were not accommodated by larger numbers of cars, but rather by more intensive use of the individual equipment units. With a 14 percent decrease in car ownership in 1958, as compared with the latter years of the twenties, the CPR nevertheless handled a 37 percent increase in traffic (loaded freight car-miles). This reflects the obvious fact that a railroad must maintain a car fleet sufficient to accomodate its anticipated long term needs, and that all temporarily unused cars cannot be scrapped with each short-run dip in traffic. Can a hotel tear down its two top floors when business is poor?

We believe that this analysis confirms that the car-mile portion of depreciation, which reflects intensity of use, does indeed vary at or near 100 percent with traffic. It also demonstrates, at least insofar as CPR is concerned, that the car-day portion of depreciation, which is a reflection of car ownership requirements, is not characterized by direct or positive variability with traffic. Expenses which lack this character must, in the present state of railway cost-ascertainment, be treated as constant costs, which has been done in the development of our cost estimates.

6. Line Haul Common Costs

A major problem in railroad cost finding relates to the substantial fraction of total cost which, under most conditions, cannot be directly assigned to a particular service or traffic. These common costs stem from the multiproduct nature of the railroad industry, with several services and kinds of traffic typically using the same facilities and/or generating the same units of production. Common costs, such as costs incurred in common by freight and passenger service must be distinguished from costs which can be directly and immediately traced and assigned to a particular transportation job. The expenses of passenger and freight trains themselves are, however, not common, but generally considered to be directly assignable. That is, with minor exceptions, it is possible in almost every case immediately to determine whether a train is freight or passenger and thus appropriately to assign train-related expenses, such as crew wages or fuel, to freight or passenger service.

A point often overlooked is that expenses which may be directly assignable for one purpose, say the determination of freight service costs, become a common cost when the analysis is directed at another goal. Thus crew wages and fuel which are directly assignable to freight service are often incurred in common by several types of traffic, all of which are freight, and such expense must therefore be allocated between the several types of freight traffic when the goal of cost ascertainment is to determine the expense attaching to an individual commodity.

In the case of statutory grain traffic, the expense of grain door installation is an example of directly assignable cost, and the expense attached to freight train operation in which grain is carried together with

other traffic is a common cost, which must be allocated between grain and other commodities carried in such trains. In describing cost allocation generally an eminent American economist has found that:

> It also offers great opportunities for the development of arbitrary and fictional notions of cost, through the necessity of apportioning items somehow, even if there is no satisfactory scientific basis on which to do it. 12

The method by which the CPR has attributed to grain its share of line-haul common cost is succinctly described at p. 2480, Vol. 18, of the transcript. The key to this method is:

> Constructive train miles used to handle the study traffic were developed based on the average weight of trains on which the study traffic moved weighted by the proportion of the study traffic to total traffic on each train-run. (Emphasis supplied.)

Manitoba/Alberta ask: is it reasonable to use average weight trains for costing purposes, when large segments of the grain movement are deliberately run as "filler" for time freights? It is already of record that a part of the grain movement is actually handled in solid grain trains,[13] and it is the position of Manitoba/Alberta that for the computation of grain movement costs such trains represent a more reasonable point of departure than cost computation based on average weight trains. We believe this follows from the fact that average weight trains reflect a tonnage reduction for manifest freights to permit them to achieve schedules and speeds required to service other traffic, but not required for the movement of grain, which can as well be serviced in so-called "drag" or full-tonnage freight trains. The influence of such manifest freight tonnage reductions upon a composite train-weight figure leads to higher unit costs. Consequently, if line-haul common costs are computed on the basis of average weight trains, the resultant higher unit

costs impute expense to the grain movement which actually arises from the service requirements of other enterprises of freight traffic.

We are not proposing that the railway policy of using grain as fill-out for manifest trains be changed. By this practice the unit costs of such trains are reduced, and there is no offsetting disadvantage to the grain movement. But Manitoba/Alberta do suggest that a cost calculation reflecting this operating practice is an erroneous approach to the present study, inasmuch as mechanical computations of actual average operating costs ignore the fact that this aspect of operating policy is primarily designed for railway convenience and the convenience of other kinds of traffic, and does not reflect the inherent operating requirements - and inherent costs - of the grain movement.

To determine that portion of line haul common costs which is an inherent cost of the grain movement, Manitoba/Alberta have computed constructive train-miles on the assumption that grain is handled in solid trains, as its volume generally justifies, over the eleven main line sub-divisions, Alyth to Vancouver and Moose Jaw to Fort William. On each sub-division a typical train motive power assignment of 1500-1800 horsepower units was determined from a sample of operating data provided by CPR. Its Assistant to the President confirmed that trains with such power did in fact operate during 1958 "probably at least once daily" on the subject sub-divisions. The same CPR sample was also used to determine, by sub-division, the ratio between "A" and net rated trailing tonnage, and such ratio was applied both to the largest actually experienced train weights of which we had record, and to the maximum tonnage rating over the ruling grades of the respective sub-divisions, as set out in the railway's Tonnage Rating Manual. The lesser, or more conservative, of the trailing tonnages computed in this manner was the

weight of train assumed for our determination of constructive train-miles. In its investigation of this subject, we hope the Commission will determine whether and to what extent the CPR has increased its average train weights since 1958.

7. Train Other Expenses - Account 402

A portion of expense in this account directly assignable to the movement of grain is grain door installation and repair cost. In its development of such cost, the CPR used an average of the annual expense incurred during the three year period 1956-57-58. Our study disclosed that grain door expense so closely reflected traffic volume in each year that the use of a 3-year average is unlikely to yield a better estimate of such expense. This conclusion was reached from the following data:

Year	Waybills at Statutory Rates	% of 3 yrs.	Grain Door Expense-CPR	% of 3 Yrs.
1958	2400	29.6	$ 761,808	30.1
1957	2572	31.8	764,580	30.3
1956	3129	38.6	1,000,347	39.6
Totals	8101	100.0	$2,526,735	100.0

Source: Board of Transport Commissioners for Canada, "Waybill Analysis Carload All-Rail Traffic, 1958"; C.P.R.

I therefore used 1958 actual grain door expense.

The great variety of services and supplies represented by the remaining charges in Account 402 requires an apportionment to grain which was originally accomplished by CPR on a system average unit cost basis. In the restatement embodied in Exhibit 132, however, the railway adopted a different method "to reflect the heavy proportion of traffic which is grain in Western Region, and the lower proportion of passenger to total in the West than on the System."[14]

Data furnished by CPR indicated that fundamental to its new method was a separation of Prairie and Pacific Region costs from system totals. Western unit costs were now apportioned to grain instead of the system averages formerly used. Although this method would appear to commend itself, as used by the railway it produces several flaws which, lacking further explanation, make it unreasonable for Manitoba/Alberta's study. These flaws include:

(a) 76 percent of the freight portion of "Other Train Expense" (total charges to Account 402 less solely related passenger expense, grain doors and lubrication costs) is charged against the West, although that area was serviced by only 56 percent of the 1958 system freight train-miles;

(b) An adjustment between original and revised methods of allocating the $5,768,045 portion of the Account designated as "Other Train Expense." As originally developed, $992,154 of this was directly assigned to passenger service, and only the remainder to all train service. As revised, the $5.8 million total was prorated on a train-mile basis to both freight and passenger services, thereby effectively increasing the share charged to freight (and thus to grain);

(c) The unit cost of "Other Train Expense"as thus computed by CPR was 17.8 cents per 1958 freight train-mile in the West, but only 8.1 cents in the East; and

(d) Heating, icing and refrigerating costs of freight carriage in the West - none of which is incurred on behalf of grain - have not been deducted from the Regional expense totals prior to an apportionment to grain.

As a consequence of the combined effect of these factors, the restatement of Train Other Expenses in Exhibit 132 appears to create a cost disparity between East and West operations which seems unjustified by any facts known to Manitoba/Alberta. We have therefore adopted for our cost study the system average method of expense apportionment originally used by CPR for the computation of unit costs in Account 402, except for the grain door adjustment noted above.

8. Loss and Damage.

CPR originally used 1958 grain loss and damage claims as a point of departure for its calculation of such costs. However, in Exhibit 132, "to make consistent with other parts of study", the average of claim payments experienced during the three-year period 1956-57-58 was substituted for the previous data. This had the incidental effect of increasing such costs, although prior to such adjustment they were already at a level roughly 50 percent above that experienced by the CNR, as follows:

1958	CPR	CNR
Claims Payments	$239,553	$131,610
Carloads	155,180	126,704
L and D/Carload	$1.54	$1.04

Due to this discrepancy, which remains unexplained despite specific inquiry, and due also to the fact that Manitoba/Alberta have used 1958 costs wherever this could reasonably be done, our study incorporates the original loss and damage cost advanced by the railway, rather than the restatement thereof which appears in Exhibit 132.

9. Yard Switching.

The large amount of switch engine time devoted to the service of grain traffic is an important factor in the latter's cost structure. In its attempt to measure such time, the CPR made field time studies of switching operations at certain Western Region yards. The data gathered by the railway from these studies was segregated into four categories, viz:

1. Switching associated with milling-in-transit.
2. Switching at origin stations.
3. Switching at intermediate yards.
4. Switching at terminating yards.

Switching associated with milling-in-transit has been discussed above. For their cost study Manitoba/Alberta have used the switching time computed by CPR for the handling of grain at country elevators and other origin points, but we believe this to be exaggerated for reasons we shall describe later. The following discussion is limited to our findings concerning switching at intermediate and terminating yards, which experience the greatest share of the switching time attributed to export grain.

From what we know of the workpapers developed at the intermediate and terminal yards, we think it likely that the railway has overstated the costs incurred by grain switching because

(1) CPR has failed to deal with the significant factor in switching costs, namely, the tendency of averages to conceal the work which is actually done. Not only has the CPR developed average costs at some yards, but it has combined switching averages in a way which uses averages of averages to arrive at further averages. Regrettably, since we had only CPR data available, we have had to do the same, but we have endeavored to recognize the weakness of averaging in assessing switching operations. We have dealt with this procedure in Memorandum No. 1, where we have tried to make a point that every switchman knows: that big cuts make faster switching.

(2) CPR apparently charges grain with certain elements of switching service which were not in fact performed for such traffic; and

(3) CPR erroneously computes and applies an adjustment for winter operation.

To try to correct the second deficiency mentioned, Manitoba/Alberta computed from the basic data for certain yards, a switch engine time for loaded and empty through grain cars; as far as those yards are concerned we have developed new grain switching costs as described below. We have also tried to adjust properly for the third deficiency.

Our initial step in the endeavor to try to find reasonable switching costs for export grain relates to the development of accurate switch engine time requirements for the service of through cars at those main line yards where no tonnage adjustment is normally required for through freight trains, i.e., at Kenora and for eastward train movements at Ignace and Field. In these yards the CPR study has assumed that all through grain cars are "classified." This is another instance where averaging is used to distort grain costs, since a large number of grain cars requiring virtually no switching are averaged with relatively few grain and other cars requiring a great deal more. In our view this is inaccurate because classification is authoritatively defined as "train make-up and break-up",[15] and this obviously is not required for pre-blocked traffic on trains which have left a sub-division and are about to proceed on another with an equal or greater tonnage rating.

It is our position that the only switching service performed for through grain cars moving in the indicated directions at Kenora, Ignace and Field relates to repair and shop track work, and a single component of classification, namely, caboose changes. By way of illustration, we believe that no switching other than that described is required at Kenora for loaded grain cars passing through in a single "Fort William" cut, nor will any be required for through empties moving westward in a solid block, and we are inclined to think that it is not the usual practice to bleed the air on such cuts when passing through points like Kenora.

When computed in accordance with our analysis, the actual switch engine time per through grain car, at the yards and in the directions indicated, is 0.4397 minutes, by contrast with the 1.1 and 0.8 minutes per loaded and empty car respectively, which is attributed to grain by the CPR.

To assure a conservative computation, Manitoba/Alberta have increased the actual switching time associated with the handling of grain cars at these yards by a factor of 10 percent to provide for contingencies.

Our second step in endeavoring to reach reasonable grain switching costs concerns the computation of switch engine time for application to cars passing through main line yards in which, unlike Kenora, a tonnage adjustment is required as main line freights leave one sub-division and enter another. This occurs as follows:

Yard	Direction of Grain Movement
Broadview	Loaded and Empty
Kamloops	do
North Bend	do
Revelstoke	do
Field	Loaded
Ignace	Empty

Using CPR data as to the number of grain cars passing through these yards during the study period, we have applied as appropriate, the switching time per car developed for Kenora, and for the same reasons. However, since a tonnage adjustment is here also necessary, we added, at the above locations, a factor for work of this type, which increased the time per through car to 1.0594 minutes actual, and 1.17 minutes including an allowance for contingencies.

Correction of the third apparent defect in the CPR yard studies relates to the weight attached by CPR in Exhibit 132 to switching under

winter conditions. The CPR method of adjusting for the unquestionably higher costs of winter yard operations rests upon the assumption that grain traffic flows at even volumes throughout the year. The fact is, however, that only 24 percent of the grain cars unloaded at the export positions were handled during the four winter months of December, January, February and March 1958. If this seasonal slack is taken into account, the so-called "winter adjustment" is reduced from 5.1 percent to 3.7 percent (15.3 percent x 24.35 percent).

10. Traffic, General and Miscellaneous Expenses

In my judgment the attempt made by the CPR to measure the maintenance and transportation expense and permissive earnings incurred by the movement of export grain was not pursued with equal vigor in the area of its Traffic, General and Miscellaneous expense. As to these cost elements, the railway was content to apportion expense to the study traffic in the ratio which it established between the freight portion thereof and the remainder of total operating expenses, including system constant, but exclusive of passenger variable costs.

Manitoba/Alberta appreciate the problem faced by CPR in the apportionment of these indirect expenses. We believe that any method evolved for the purpose must in the present state of rail cost analysis, be rather more than less arbitrary. At the same time we believe that we have developed a method of apportioning these expenses which approaches more closely to the facts of the matter than that which has been used by the railway.

To this end, our analysis embodies several departures from the CPR method yielding results such as are shown in Exhibit 68 (Revised). We have

adjusted the CPR's passenger/freight separations in certain accounts, and have developed and/or applied methods other than that used by the railway to apportion Tax, Traffic and Communications-Rail Expense. Finally, we have computed these costs so that their constant portion is entirely attributable to freight service, and also, for comparison, so that an appropriate portion of fixed cost is borne by passenger (including commutation) service.

Lacking detailed information on the methods used elsewhere, our adjustment of the freight/passenger expense separations accomplished by the railway was limited to taxes, discussed below, and to the maintenance and operation costs of system rail communications. The CPR separates the latter on a train-hour basis, which in my opinion tends to place an unduly heavy burden on the freight service, since separation on such a basis implies that the paramount use of communications is for control of train operations, with no weight whatsoever given to the extensive communications requirements for other transportation purposes, for maintenance of road and equipment, for general superintendence and for traffic solicitation and servicing. Inasmuch as the separation formula used by the I.C.C. recognizes these other burdens on rail communications networks, we have adopted and applied it to CPR's total Communications-Rail Expense, using a passenger/freight proration which reflects U.S. rail experience in 1958.

A share of the freight portion of Traffic Expense was apportioned to the export grain movement by CPR in a conventional manner, which is to say, in the proportion which grain transportation, maintenance and earnings variable expense related to system total freight variable expense in these categories. This convention is adopted, by CPR and others, simply because available data do not lend themselves to more refined techniques. Likewise, the development of improved data through special time and supply

use studies directed to the personnel and material expense in these accounts are deemed infeasible for various reasons. There is already of record, however, extensive testimony demonstrating the inapplicability of conventional methods of apportioning costs of this character to the movement of Canadian grain to export positions.[16]

In light of the facts disclosed by this testimony, and the statutory status of grain freight rates, it is obvious that certain normal traffic department activities are here precluded. We have therefore allocated to grain that portion of freight Traffic Expense which corresponds to the ratio between grain revenue and total system freight revenue. This is an unusual apportionment method, but I believe it to be justified for the purpose of costing grain.

Non-income tax accruals were charged by the CPR against the studied traffic in the same manner as Traffic Expense. Our departure from their method involves an analysis of such taxes by their nature, and assignment or apportionment as seemed reasonable in view of the information we possessed.

Data available from the Dominion Bureau of Statistics, supplemented by CPR, enabled us to separate 1958 tax accruals into three categories: Real Property Taxes, Wage-Related Taxes, and Provincial Taxes.

The 1959 ad valorem tax accruals on lines substantially related to the service of export grain were directly assigned to the study traffic, and treated as a variable cost. The remaining taxes in this category were apportioned on a track-mileage basis between lines substantially related to other traffic, and remaining system track mileage. The tax expense apportioned to non-grain substantially related lines was treated as a variable expense of such lines, passenger and freight separately; the remaining system Real Property Tax was apportioned between passenger

and freight services on the basis of the variable expense of the respective services.

Wage-Related Taxes we defined as the sum of Old Age Retirement, Unemployment and Payroll taxes. These we separated between the passenger and freight service on the basis of 1958 pension expense. This is admittedly only a rough guide for the purpose; actual 1958 wage payments to the two services would be a more reasonable basis, but in the absence of that information, we believed an attempt to separate these taxes by some such method was preferable to the procedure attempted by the railway.

Provincial taxes were pro-rated between passenger and freight service on the basis of CPR's own separation of Account 468.

The determination of grain's share of the freight portion of (a) Wage Related and Provincial Taxes, and (b) General, Communications - Rail Expense and Rents, involved two steps. The first was the separation of such expenses into variable and constant portions, in the ratio of system freight variable expense to system freight constant expense, excluding Traffic, General and Miscellaneous Expenses. Secondly, the variable was allocated to grain in the ratio between the sum of these expenses and system freight operating expenses, excluding Traffic, General and Miscellaneous Expenses. Finally, the constant portion of these expenses was allocated to grain on the basis of the variable.

D. Constant Cost Considerations

With the techniques presented in this study, two alternate methods of constant cost determination are available. Neither of these is preferable in itself, and each poses problems for the cost analyst.[17]

Once a determination of such costs is reached by either method another profound and unsolved problem must be faced, namely, their apportionment among various categories of traffic. By any method thus far evolved, this is accomplished in a necessarily arbitrary manner. The basic method employed by the CPR (aside from the specifics of its application) in which constant cost is apportioned between grain and other traffic in the ratio of grain variable to total freight variable cost is neither more nor less arbitrary than other methods which could have been used. Had the CPR's apportionment of constant cost been accomplished on a ton and ton-mile basis, in accordance with established Interstate Commerce Commission practice, the results would, of course, have been more unfavorable to grain than the numbers which the railway chose to advance; they would, however, have been no more meaningful.

To provide an indication of the variety of results attainable by means of different fixed cost apportionment methods, we have prepared several analyses of such costs which are developed in accordance with the two alternative methods mentioned above. In their application we have in some cases, put the entire burden of system fixed cost upon the freight service, as did the CPR, and in other cases we have made adjustments to arrive at more appropriate results, as described below. In all, Manitoba/Alberta have developed six patterns for apportionment of constant costs, as follows:

Non-Size Related Constant Cost

1. Based on regression equations, without apportionment of constant costs to passenger service;
2. Based on regression equations, with apportionment of constant costs to passenger services;
3. Reconciled with reported expenditure, without apportionment of constant costs to passenger services;
4. Reconciled with reported expenditure, passenger services bearing an appropriate share of constant cost;

Size Related and Geographic Constant Cost

5. Without an apportionment to the passenger services; and
6. With an apportionment to passenger services.

From these analyses a range of constant costs emerges which, when added to computed variable costs, will fix the probable upper and lower magnitudes of full cost appropriately attributable to the CPR's movement of statutory grain.

In our judgment, those analyses which attach a share of constant cost to the passenger services are of greater validity than those which do not. This follows from the fact that comparisons of like with like - in this case of two allegedly deficit traffics - should be developed and computed in a uniform manner if they are to provide a sound basis for governmental assessment of national transport problems. CPR may regard passenger traffic as incremental traffic, and may properly evaluate it from that standpoint for managerial guidance, but it is open to serious question whether this is an appropriate basis for developing cost data which are meant to contribute to the determination of public policy. In our opinion, it is not.

In the development of our non-size related constant costs according to patterns 3 and 4, above, we have eliminated certain operating expenses which, although embodied in Exhibit 69 (Revised), are in my opinion improperly designated as expense which must be apportioned to export grain movement, namely:

1. Portions of Depreciation Expense charged to Accounts 266 or 331 relating to

   a) storage warehouses
   b) wharves
   c) grain elevators
   d) other structures
   e) vessels

2. Other Operating Expense charged to

   a) Account 375 (coal and ore wharves)
   b) Account 408 (operating vessels)
   c) Account 443 (operating grain elevators)
   d) Account 446 (other activities, stockyards, cold storage plants, etc.)

Our analyses of size-related costs exclude from system constant the track mileage of lines substantially related to other traffic or services, including passenger. Although CPR omitted such an adjustment from Exhibit 70 (Revised), it has included such costs as an element in its passenger train service study.[18]

E. Areas of Imprecision

The constant and variable costs developed in the manner described above, when integrated with those CPR cost coefficients which have been properly computed are believed to provide an improved measure of the movement cost of export grain during 1958.

Our study however, also indicated other areas which seem to warrant additional research if greater precision is deemed desirable in assessing

statutory grain movement costs both past and prospective. These areas are briefly described below.

1. <u>Overestimate of Track-Miles Substantially Related to Grain.</u>

Among the tests used by CPR to determine whether branch lines were substantially related to the handling of the grain was a comparison of net non-grain revenues with size-related costs on each individual branch line. Where the former (i.e. non-grain net revenues) exceeded the latter (i.e. size-related costs) a line was excluded from the group we term "substantially related;" where the former was less than the latter, the track-mileage of such a line was included in this group.

Upon this standard, and with application of size-related costs used by the CPR, variable expense of $6,255,360 was attributed to statutory grain traffic,[19] taking into account the net revenue contribution of non-grain traffic carried on the substantially related lines, but excluding overhead expense allocated on a basis which includes a portion of the $6.3 million.

Since our estimate of size-related cost is substantially below that used by the CPR, it follows that any comparison of net non-grain revenues with Manitoba/Alberta's size-related costs would produce a different, and smaller, amount of substantially related track-miles, which in turn would diminish the variable costs attributable to grain.

At the same time, the application of our unit cost coefficients to the output units of non-grain traffic on substantially related lines would unquestionably produce a net revenue contribution by this traffic which varies from that computed by the railway. Hence, with different size - related costs, and also with different cost coefficients, a calculation of

substantially related costs which fully reflected other aspects of our study would produce, we believe, a diminishment in the variable costs attributed to grain by our study as it stands. We conclude therefore that the variable costs of substantially related lines, as presently shown in Table 5, represent an overestimate.

2. Overstatement of Train Switching Costs.

Another overstatement of the variable costs of grain movement which is reflected in both the CPR and Manitoba/Alberta studies concerns train switching, the operating activity in which road engines perform switching services at grain origin points and smaller yard locations. The cost overstatement which stands uncorrected arises from two factors:

(1) That station reloads were not taken into account; and

(2) That the effect of multiple car cuts on train switching at grain origin points has not been computed.

The CPR developed its train switching costs at grain origin points by attribution of the same switching time to each carload of grain originating on a particular division. This procedure was imprecise because it ignored the existence of station reloads, i. e., cars which arrive at a station under load with a different commodity (such as suitable feeds, fertilizer, cement, etc.), and after unloading of the inbound consignment are reloaded with grain without further switching by CPR forces. I am advised that, varying by location, such reloading may be done at the point where the inbound car has been off-loaded, or alternatively, the car to be reloaded may be shifted by elevator employees to an adjacent location on the grain siding. I am also informed that in some instances, where inbound receiving

platforms are at an industrial siding some distance removed from the grain siding, CPR does perform a switching service between the inbound and outbound road movements, but that this is not the case at a great many stations.

In that part of its study relating to this matter however, the CPR has developed its costs from the assumption that a car must be "spotted" (i.e., placed in position), as well as "pulled" (i.e., gathered for outbound train movement) in every instance where a carload of statutory grain is originated. It is our position that a substantial fraction, perhaps the preponderant portion, of station reload cars used for the grain movement require no spotting,only pulling, by CPR. Thus it follows that attribution of both switching elements to grain where both do not in fact take place involves an exaggeration of costs actually incurred.

Manitoba/Alberta's Memorandum No. 1 described the effect of multiple car cuts on classification switching costs. It is our view that similar cost savings attach to the train switching of grain cars at some origin stations,because the number of grain cars which can be handled simultaneously at those stations exceeds the all-traffic average.

3. Transitional Costs of Dieselization.

Manitoba/Alberta have made a specific effort to isolate the costs which might be attributable to a transition from steam to diesel power, in the belief that such costs were of a short term nature, operative perhaps in 1958, but certainly irrelevant in assessing costs that could be anticipated for the future, now that Canadian railroads are, for all practical purposes, fully dieselized. This effort has not been fruitful,

due to the limitations in available data. Nonetheless we share the opinion of the Honorable Mr. Justice John D. Kearney that

> ...Canadian Pacific (profiting by the experience of dieselization in the United States) is restricting so far as possible during a transition period the disadvantages of a mixture of steam and diesel operation, nevertheless, so long as such a condition remains, there is some wholly unavoidable duplication of costs. As one instance, passing and terminal tracks and other facilities suitable for steam locomotives are in many instances inadequate for diesel locomotives with their additional power and capacity to carry longer and heavier loads.[20]

That these apprehensions are shared by those having access to all the facts is described by a difference of opinion on record between CNR and the CPR as to this matter.[21]

In summary, our view is that a possibility exists of cost distortions due to assumption by the CPR for the purposes of cost analysis, of a mix of steam and diesel motive power in 1958.

4. A Constancy in Crew Wages?

The conventional approach to crew wage costs regards these as 100 percent variable with traffic. This view is, however, not shared by all. This is evident from the Verified Statement of Roger W. Wright, Assistant Superintendent of Transportation of The Minneapolis, St. Paul & Sault Ste.Marie Railroad Company, a CPR subsidiary, in a recent I.C.C. proceeding, I & S. No. 7276, Petroleum-Watertown and Twin Cities to North Dakota, South Dakota and Wisconsin, pertinent portions of which state as follows:

> "I have been employed by the Soo Line for 23 years.... The destination stations involved in this proceeding in North and South Dakota are located on two branch lines of the Soo Line.... Both of these branch lines are maintained almost exclusively for the handling of grain. More than 90% of the outbound shipments from stations on these lines consists of grain.... Because of the light density of traffic on these lines they are minimum

> maintenance lines. In other words, the maintenance on these lines is caused primarily by weather conditions and does not vary from year to year because of the flow of traffic.... I have made a study of the wages paid to train and engine crews on trains 75-76 and 80-81 by month for the year 1959.... It can be seen ... that the wages of train and engine crews remain practically constant on these two lines regardless of the traffic handled. This is because of the light density of the traffic on this portion of the line and that fact that additional traffic can be handled easily within the assignments of the present train and engine crews.
>
> The number of cars handled per day by these trains also varies considerably, but the wages paid to train and engine crews is constant. No overtime payments were incurred by any of these trains during 1959.... We could have handled 102 cars or more of this traffic to these stations in 1959 at no material increase in these expenses over the amounts that were actually paid."

Although Mr. Wright's study was confined to the year 1959, and his data may therefore not be construed as pertinent to measurement of long-term variable cost, Manitoba/Alberta believe that there may nevertheless be some substance to his position. Although some CPR trains are said to be operated on an on-call basis, there may very likely be others where the payment practices for railway labor combine with operating and traffic conditions to yield essentially constant wage payments over periods of many years, if adjustments are made for general wage increases. In our opinion, the existence of a constant element in CPR branch line crew wages, which stems from unutilized capacity, must be researched through before it can be dismissed. To the extent that such a constant factor may present on some grain branch lines, the cost studies of both CPR and Manito Alberta overstate their crew wage components.

5. Road Engine Fixed Cost

Manitoba/Alberta have accepted and used without adjustment the locomotive unit maintenance costs computed by the CPR, as well as the

railway's assumption that such costs are 100 percent variable with traffic. But it should not be overlooked that the possibility is present that this procedure may materially overstate the variability of such costs. A recent detailed investigation of 25 large U.S. railroads came to the conclusion that, as to these roads, during the years 1947-50

> .... a substantial fixed cost for [diesel] road engine maintenance is indicated by the very large constant of $1,080,875 which is approximately one-quarter of the total average maintenance outlay made by the twenty-five large included systems.[22]

In our view, if the cited findings are valid for the U.S. roads, they must, at least to some extent, be valid also in Canada, which uses the same railroad technology. We believe it to be highly unlikely that locomotive maintenance could be 75 percent variable with traffic in the U.S. and fully 100 percent variable in Canada. And to the degree that this apparent discrepancy remains unresolved, the variable costs attaching to grain in both our study and the railway's, may be overstated.

6. Future Yard Costs will be Reduced at some CPR Locations.

Although inappropriate to cost development for the year 1958, it is not inappropriate for the determination of future policy, to consider the impact upon cost of operating improvements currently taking place on the CPR. As to these, an authoritative trade journal reports that

> Canadian Pacific will install CTC for train movements through the Winnipeg terminal area. With the two-way radios on yard engines, the railway estimates that crews will be able to spot cars at customers' sidings in half the time now required, and all traffic will move through Winnipeg 30% faster.[23]

F. Summary of Results

The Manitoba/Alberta study has employed many cost components and coefficients developed by the CPR. It has also leaned heavily, although not exclusively, upon data which the railway provided. It has directly assigned some costs, apportioned others, and used regression regults as appropriate. Its findings represent a research effort of substantial proportions. By this effort the Provinces have satisfied themselves that the CPR cost study contains numerous overstatements. So numerous are these, and of such a magnitude, that they have attached to the grain movement a deficit stigma which it does not merit.

Manitoba/Alberta find that 1958 revenues from the movement of statutory grain to export positions, far from imposing a burden on other traffic or upon the Canadian Pacific's general financial position, do in fact cover grain's variable movement costs fully and also make some contribution to the fixed costs of the railway's plant. The difference between the revenue from Crow's Nest grain traffic and the sum of variable plus an apportionment of constant cost will be found to be in a range of from \$9,784,862 to \$14,428,754 when related to 1958 operations. This shortfall from total cost coverage is believed to be a characteristic of the revenue contributions made by many commodities other than statutory grain which move on the railways in Canada. Manitoba/Alberta therefore find no substance to the theory that the Crow's Nest Pass rates represent an inequity in the Canadian railway rate structure.

The following table summarizes the results of the Manitoba/Alberta cost study:

ESTIMATES OF THE 1958 COST
TO THE CANADIAN PACIFIC RAILWAY
OF HANDLING CROW'S NEST GRAIN FROM
THE COST ANALYSIS CONDUCTED FOR
THE GOVERNMENTS OF MANITOBA AND ALBERTA

Variable Expense Group	Table No.	Cost or Revenue
Road Maintenance	1	$ 2,457,732
Equipment Maintenance	2	7,962,534
Transportation	3	11,538,929
Permissive Earnings	4	4,886,417
Lines Substantially Related to Grain	5	3,174,175
Traffic, General & Miscellaneous	6	4,294,257
Total Variable Expense		34,314,044
Revenues from Traffic		34,899,954
Net Contribution to Fixed Cost		585,910
Constant Expense Group		
Non-Size Related Fixed Cost		
- Estimated Minimum	7	6,662,450
- Estimated Maximum	8	9,780,748
Size-Related Fixed Cost		
- Estimated Minimum	9	3,708,322
- Extimated Maximum	9	5,233,916
Revenue Shortfall from Estimated Maximum Total Cost		$14,428,754
Revenue Shortfall from Estimated Minimum Total Cost		9,784,862

Notes to Text

1. Transcript, Vol. 19, pp. 2648, 2760

2. Board of Transport Commissioners for Canada, Judgment, Rate Base - Rate of Return, February 15, 1954, p. 19, emphasized paragraph.

3. Meyer, John R; Peck, Merton J; Stenason, W. John; and Zwick, Charles, The Economics of Competition in the Transportation Industries, Harvard, 1959, p. 290

4. Transcript, Vol. 18, p. 2479

5. Interstate Commerce Commission, Statement 4 - 54, Explanation of Rail Cost Finding Procedures and Principles Relating to the Use of Costs, Washington, November 1954, p. 131.

6. Transcript, Vol. 66, p. 11662

7. Letter, W. J. Stenason to R. L. Banks, May 16, 1960

8. Transcript, Vol. 66, p. 11662

9. Transcript, Vol. 18, p. 2593

10. Transcript, Vol. 19, p. 2708

11. Letter, W. J. Stenason to R. L. Banks, May 6, 1960

12. Clark, J. M., Studies in the Economics of Overhead Costs, Chicago, Revised Ed., 1957, p. 14

13. Exhibit No. 142, and Transcript, Vol. 66, pp. 11694-5

14. Op.cit., p. 6

15. Interstate Commerce Commission, op. cit., p. 125

16. Transcript, Vol. 66, p. 11713 et. sub.

17. Memorandum No. 1, p. 38 et. sub.

18. Submission of Canadian Pacific Railway Concerning Passenger Train Service, September 15, 1960, p. 74

19. Exhibit No. 67 (Revised)

20. Board of Transport Commissioners for Canada, op. cit., pp. 67-8.

21. Transcript, Vol. 68, pp. 12118-12126

22. Meyer, et. al., op. cit., p. 298

23. Railway Age, November 2, 1959, p. 41

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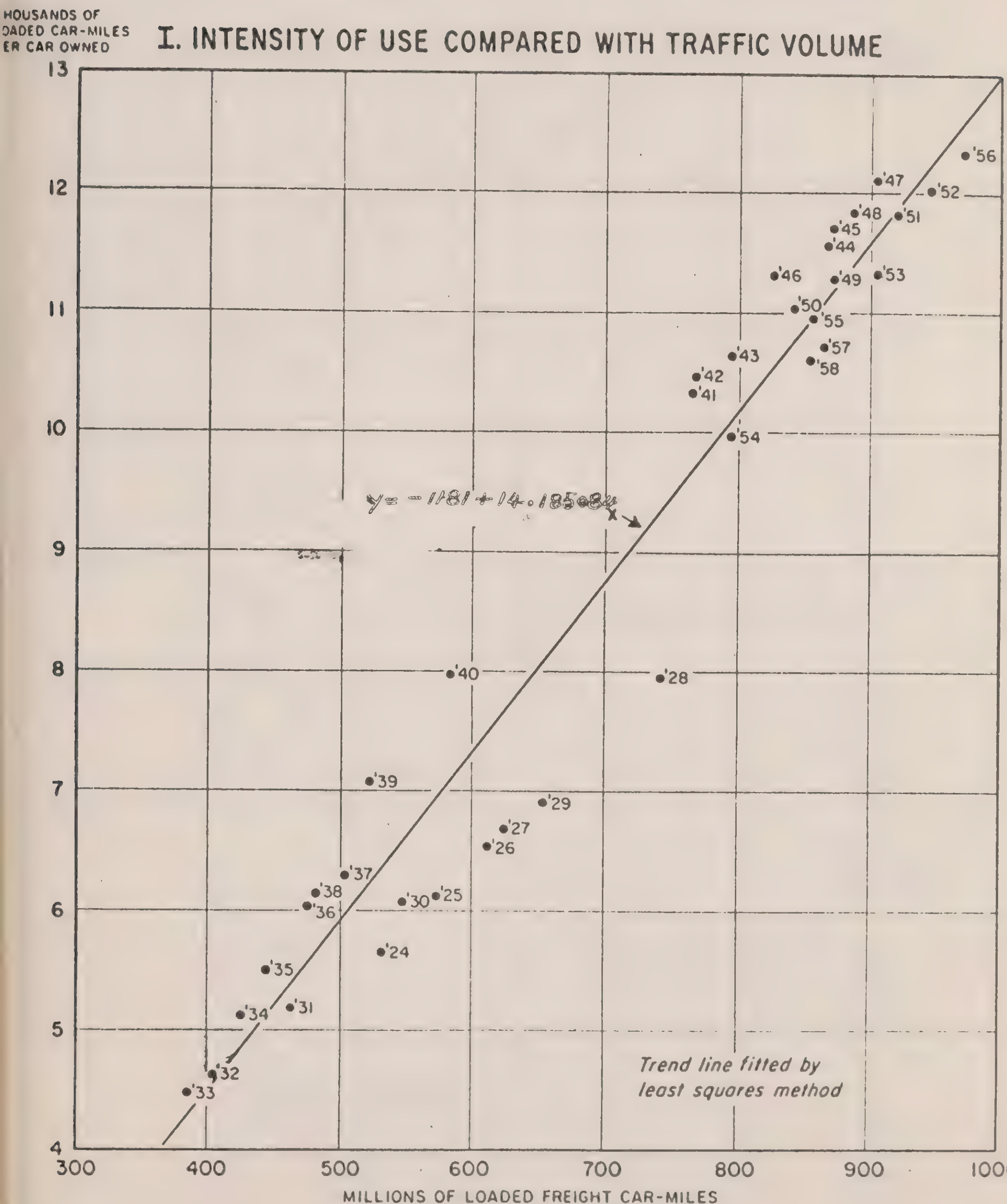
CHART I
Manitoba-Alberta
Memorandum No. 2
Exhibit No. ______

CANADIAN PACIFIC RAILWAY

(including subsidiary companies in Canada)

Freight Car Trends, 1924 through 1958

I. INTENSITY OF USE COMPARED WITH TRAFFIC VOLUME



Source: Dominion Bureau of Statistics

19250

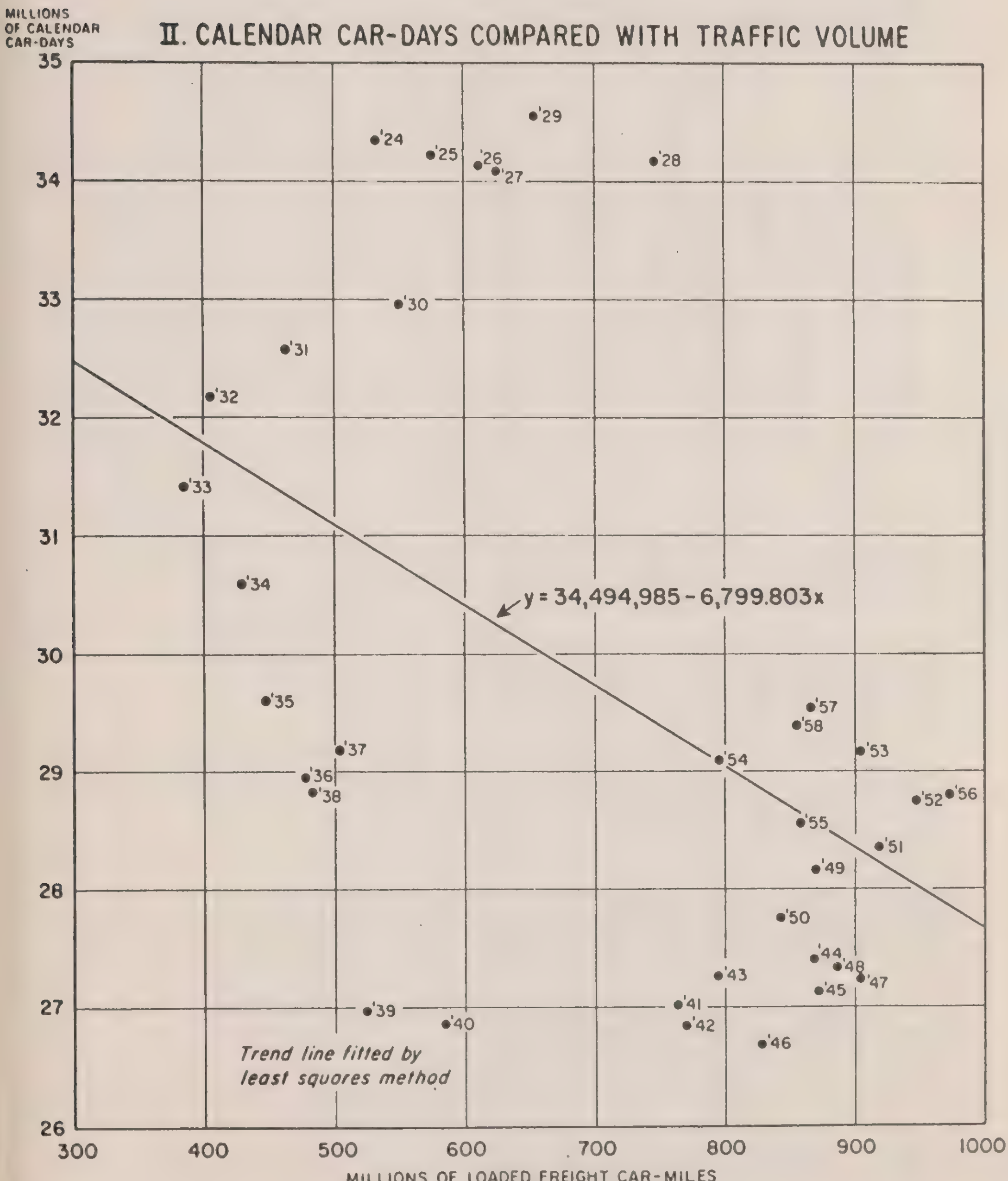
CHART II
Manitoba-Alberta
Memorandum No. 2
Exhibit No. ______

CANADIAN PACIFIC RAILWAY

(including subsidiary companies in Canada)

Freight Car Trends, 1924 through 1958

II. CALENDAR CAR-DAYS COMPARED WITH TRAFFIC VOLUME



Source: Dominion Bureau of Statistics

Table No. 1
Manitoba-Alberta
Memorandum No. 2
Exhibit No. ____

MANITOBA AND ALBERTA
Variable Road Maintenance Expense
Crow's Nest Grain, Year 1958

Acct. No.	Expense Description	Independent Variable	Unadjusted Unit Cost	Adjustment Factor	Adjusted Unit Cost	Suptce. Unit Cost	Total Unit Cost	Units	Variable Cost
201, etc.	Road Maintenance Superintendence & Overhead	Road Mtce. Expenses Excl. Suptce.	$0.03288	1.59587	$0.05247	-	-	-	-
202, etc.	Track Maintenance & Depreciation	Train Miles	0.38960	1.01430	0.39517	$0.02044	$0.41561	3,513,951	$1,460,433
202, etc.	Track Maintenance & Depreciation	Yards & Train Switching Miles	0.43868	1.01430	0.44495	0.02302	0.46797	828,054	387,504
227, 266	Station & Office Bldg. Maint. & Deprec.	Carloads	1.33237	1.06861	1.42378	0.06991	1.49369	175,203	261,699
231, 266	Water & Fuel Station Maint. & Deprec.	Dollars of Fuel Expense	0.01070	1.00285	0.01073	0.00056	0.01129	2,552,753	28,821
231, 266	Water & Fuel Station Maint. & Deprec.	Dollars of Water Expense	0.45140	1.00285	0.45269	0.02368	0.47637	57,316	27,304
235, 266	Shops & Enginehouse Maint. & Deprec.	Yard & Train Switching Miles	0.10259	1.31299	0.13470	0.00538	0.14008	828,054	115,994
249, 266	Signals Maintenance and Deprec.	Train Miles, Main Line	0.04772	1.06483	0.05081	0.00250	0.05331	2,538,683	135,337
253, 266	Power Plants Maint. & Deprec.	Yard & Train Switching Miles	0.01270	1.23230	0.01565	0.00067	0.01632	828,054	13,514
	Sub-total		-	-	-	-	-	-	$2,430,606
275, etc.	Insurance and Joint Facilities	Dollars of Road Maint. Expense	0.01060	1.00000	0.01060	0.00056	0.01116	2,430,606	27,126
	Total Road Maintenance								$2,457,732

Table No. 2
Manitoba-Alberta
Memorandum No. 2
Exhibit No.____

MANITOBA AND ALBERTA
Variable Equipment Maintenance Expense
Crow's Nest Grain, Year 1958

Acct. No.	Expense Description	Independent Variable	Unit Cost	Units	Variable Cost
308-311	Road Locomotive Repairs	Train Miles	$0.39718	3,513,951	$1,395,671
308-311	Road Locomotive Repairs	Train Switching Miles	0.34653	227,527	78,845
308-311	Yard Locomotive Repairs	Yard Switching Miles	0.20762	600,527	124,681
314	Freight Train Car Repairs	Car Miles	0.01528	213,831,793	3,267,350
314	Freight Train Car Repairs	Car Days	0.57221	1,528,752	874,767
326	Work Equipment Repairs	Dollars of Road Maintenance Expense	0.01352	2,457,732	33,229
	Repair Expense				$5,774,543
331	Road Locomotive Depreciation	Train Miles	0.16496	3,513,951	$ 579,661
331	Road Locomotive Depreciation	Train Switching Miles	0.26799	227,527	60,975
331	Yard Locomotive Depreciation	Yard Switching Miles	0.14384	600,527	86,380
331	Freight Train Car Depreciation	Car Miles	0.00408	213,831,793	872,434
331	Work Equipment Depreciation	Dollars of Road Maintenance Expense	0.00437	2,457,732	10,740
	Depreciation				$1,610,190
301, etc.	Superintendence & Overhead	Dollars of Repair Expense	0.10006	5,774,543	$ 577,801
	Total Maintenance of Equipment Expense				$7,962,534

Table No. 3
Manitoba-Alberta
Memorandum No. 2
Exhibit No. _____

MANITOBA AND ALBERTA
Variable Transportation Expense
Crow's Nest Grain, Year 1958

Acct. No.	Expense Description	Independent Variable	Unadjusted Unit Cost	Adjustment Factor	Adjusted Unit Cost	Suptce. Unit Cost	Total Unit Cost	Units	Variable Cost
371, etc.	Transportation Superintendence & Overhead	Dollars of Transportation Expense	$0.02442	1.79756	$0.04390	-	-	-	-
372, etc.	Dispatching & Station Employees & Expenses	Thousands Gross Ton Miles	0.05644	1.44182	0.08138	$0.00248	$0.08386	12,233,795	$1,025,926
377	Yardmasters & Clerks	Yard Switching Miles	0.46992	1.09439	0.51428	0.02063	0.53491	600,527	321,228
378, etc.	Yard Expenses	Yard Switching Miles	2.37435	1.00498	2.38617	0.10423	2.49040	600,527	1,495,552
386, 388	Yard Other Expenses	Yard Switching Miles	0.14389	1.01193	0.14561	0.00632	0.15193	600,527	91,238
398, 400	Train Enginehouse Exp. & Tr. Loco. Other Sup.	Locomotive Miles	0.13410	1.02378	0.13729	0.00589	0.14318	3,741,478	535,705
397	Train Locomotive Water	Locomotive Miles	0.01331	0.99913	0.01330	0.00058	0.01388	3,741,478	51,932
402	Train Other Expense	Car Miles	0.00251	1.00000	0.00251	0.00011	0.00262	213,831,793	560,239
402	Train Other Expense	Train Miles	0.11001	1.00000	0.11001	0.00483	0.11484	3,513,951	403,542
402	Train Other Expense -- Grain Doors	Carloads Grain	4.34111	1.00000	4.34111	0.19057	4.53168	150,319	681,198
404	Signal Operation	Train Miles, Main Line	0.01146	1.06483	0.01220	0.00050	0.01270	2,538,683	32,241
418	Loss & Damage - - Grain	Thousands Revenue Ton Miles	0.03404	1.23806	0.04214	0.00149	0.04363	7,037,405	307,042
392, 401	Train Enginemen & Trainmen - Road	Direct	3,059,142	1.01152	3,094,383	134,296	3,228,679	-	3,228,679
392, 401	Train Enginemen & Trainmen --Train Switching	Train Switching Miles	0.91208	1.01152	0.92259	0.04004	0.96263	227,527	219,024
394	Train Locomotive Fuel & Power - Road	Direct	2,415,620	0.94960	2,293,873	106,046	2,399,919	-	2,399,919
394	Train Loco. Fuel & Power -- Train Switching	Train Switching Miles	0.18577	0.94960	0.17641	0.00816	0.18457	227,527	41,995
	Sub-total		-	-	-	-	-	-	$11,395,460
390, etc.	Joint Facilities & Insurance	Dollars of Transportation Expense	0.01206	1.00000	0.01206	0.00053	0.01259	11,395,460	143,469
	Total Transportation Expense								$11,538,929

Table No. 4
Manitoba-Alberta
Memorandum No. 2
Exhibit No.____

MANITOBA AND ALBERTA
Permissive Earnings Upon Road Property and Equipment
Crow's Nest Grain, Year 1958

Expense Description	Independent Variable	Unit Cost	Units	Variable Cost
Road Property	Thousands Gross Ton Miles	$0.12273	12,233,795	$1,501,454
Diesel Yard Locomotives	Yard Switching Miles	0.13875	600,527	83,323
Diesel Road Locomotives	Train Miles	0.16550	3,513,951	581,559
Diesel Road Locomotives	Train Switching Miles	0.12756	227,527	29,023
Steam Locomotives	Yard Switching Miles	0.03259	600,527	19,571
Steam Locomotives	Train Miles	0.02310	3,513,951	81,172
Steam Locomotives	Train Switching Miles	0.10215	227,527	23,242
Freight Train Cars	Car Miles	0.01150	213,831,793	2,459,066
Work Equipment	Thousands Gross Ton Miles	0.00423	12,233,795	51,749
Shop & Power Plant Machinery	Train Miles	0.01601	3,513,951	56,258
Total Permissive Earnings				$4,886,417

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Table No. 5
Manitoba-Alberta
Memorandum No. 2
Exhibit No. ____

MANITOBA AND ALBERTA
Cost of Lines Substantially Related
to Crow's Nest Grain, Year 1958

Acct. No.	Expense Description	Size Variable	Unit Cost	Adjustment Factor	Adjusted Unit Cost	Units	Total	Substantially Related Cost
	A. Road Maintenance and Depreciation							
201, etc.	Road Maintenance Superintendence & Overhead	Miles of Track	$ 43.92223	1.64255	$ 72.14446	3,114.9	$ 224,722	
202, etc.	Track Maintenance & Depreciation	do	742.52000	1.04397	775.16860	3,114.9	2,414,573	
221, 266	Fences, Snowsheds & Signs Maintenance & Depreciation	do	58.83700	0.98747	58.09977	3,114.9	180,975	
	Superintendence Per Dollar of Direct Road Maintenance	do	801.35700	0.05247	42.04720	3,114.9	130,973	
	Total Road Maintenance				$947.46003	3,114.9		$2,951,243
	B. Investment in Road Property							
	Gross Property Investment Associated with Miles of Track	do			$ 12,520	-	-	
	Accrued Depreciation at 36.07%	do			4,516	-	-	
	Net Investment	do			$ 8,004	-	-	
	Gross Permissive Earnings at 5.587%				447.18348	3,114.9	-	1,392,932
	Total Substantially Related Maintenance Cost and Permissive Earnings							$4,344,175
	Credit Net Contribution Non-Grain Traffic							1,170,000
	Net Substantially Related Maintenance Cost & Permissive Earnings							$3,174,175

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Table No. 6
Manitoba-Alberta
Memorandum No. 2
Exhibit No.____

MANITOBA AND ALBERTA
Variable Traffic, General and Miscellaneous Expense
Crow's Nest Grain, Year 1958

Primary Account or Expense Description	Apportionment Basis	Cost	Ratio	Variable Cost
General	Tables 1-2-3-5	$24,910,438	0.11772	$2,932,457
Communications-Rail	do	24,910,438	0.01926	479,775
Rents	do	24,910,438	0.00175	43,593
Taxes	do	24,910,438	0.00906	225,689
Sub-total		24,910,438	0.14779	$3,681,514
Traffic	Ratio Statutory Grain to System Freight Revenue			393,473
Traffic	Table 5			4,595
Taxes on Substantially Related Lines	Directly Assigned			214,675
Total Traffic, General, Communications-Rail, Rents and Tax Expense				$4,294,257

Table No. 7
Manitoba-Alberta
Memorandum No. 2
Exhibit No. ____

MANITOBA AND ALBERTA

Non-Size Related Constant Costs of Crow's Nest Grain, Year 1958

Based on Regression Equations, With and Without Apportionment to Passenger Services

Acct. No.	Expense Description	System Constant	Adjustment Factor	Adjusted Constant	Suptce. Adjustment	Total Constant System	Total Constant Grain	Freight System	Freight Grain a/	Passenger System	Passenger Grain b/
	A. Road Maintenance										
201, etc.	Road Maintenance, Superintendence & Overhead	$ 1,083,445	1.64255	$ 1,779,613	-	$ 1,779,613					
202, etc.	Track Maintenance & Depreciation	8,608,904	1.04397	8,987,438	$295,507	9,282,945					
221, 266	Fences, Snowsheds & Signs	604,565	0.98747	596,990	19,629	616,619					
227, 266	Station & Office Bldg. Maintenance & Depreciation	335,328	1.09987	368,817	12,127	380,944					
231, 266	Water & Fuel Station Maintenance & Depreciation	285,035	1.03218	294,207	9,674	303,881					
235, 266	Shops & Enginehouse Maintenance & Depreciation	555,882	1.35139	751,213	24,700	775,913					
253, 266	Power Plants Maintenance & Depreciation	31,726	1.26834	40,239	1,323	41,562					
270	Dismantling Retired Road Property	158,963	1.02925	163,613	5,380	168,993					
272	Removing Snow, Ice & Sand	3,519,435	1.02925	3,622,378	119,104	3,741,482					
	Sub-total Road Maintenance					$17,091,952					
	B. Equipment Maintenance										
301	Equipment Maintenance, Superintendence & Overhead	380,520	2.00526	763,042	-	$ 763,042					
326	Work Equipment Repairs	343,092	1.02900	353,042	17,617	370,659					
331	Work Equipment Depreciation	130,015	-	130,015	-	130,015					
331	Freight Train Car Depreciation	7,073,838	-	7,073,838	-	7,073,838					
	Sub-total Equipment Maintenance					$ 8,337,554					
	C. Transportation										
371	Transportation Superintendence & Overhead	1,320,747	1.82019	2,404,010	-	$ 2,404,010					
373	Station Employees, Expenses & Dispatching	11,436,581	1.45997	16,697,065	407,742	17,104,807					
377	Yardmasters & Clerks	669,813	1.10817	742,267	18,126	760,393					
386	Yard Locomotive Supplies & Enginehouse Expenses	12,130	1.02467	12,429	304	12,733					
398, 400	Train Enginehouse Expenses & Train Loco Supplies	1,983,293	1.03667	2,056,020	50,208	2,106,228					
405, 406	Crossing Protection & Drawbridge Operation	418,578	1.01259	423,848	10,350	434,198					
	Sub-total Transportation					$22,822,369					
	Sub-total					$48,251,875	$5,969,722	$33,566,899	$4,152,897	$14,684,976	$1,816,825
	D. Other Operating Expense										
	General, Rents, Rail-Communications & Taxes					$ 6,035,856	$ 746,756	$ 4,960,922	$ 613,765	$ 1,074,934	$ 132,991
	Traffic					1,665,572	75,137	803,235	75,137	862,337	-
	Total Other Operating Expense					$ 7,701,428	$ 821,893	$5,764,157	$ 688,902	$ 1,937,271	$ 132,991
	E. Permissive Earnings				Rate						
	On Road Property	586,360,167	0.63930	374,860,055	0.05587	$20,943,431	$2,591,121	$14,569,507	$1,802,539	$6,373,924	$ 788,582
	On Work Equipment	4,878,483	0.33128	1,616,142	0.05587	90,294	11,171	77,018	9,529	13,276	1,642
	On Shop Equipment	2,968,257	0.66168	1,964,036	0.05587	109,731	13,576	69,373	8,583	40,358	4,993
	Total Permissive Earnings					$21,143,456	$2,615,868	$14,715,898	$1,820,651	$6,427,558	$ 795,217
	F. Total System Constant Costs					$77,096,759	$9,407,483	$54,046,954	$6,662,450	$23,049,805	$2,745,033

a/ Represents grain's share of system constant cost if passenger service apportioned a fair share.

b/ Represents reduction in grain's constant cost if passenger service bears fair share of system constant.

Table No. 8
Manitoba-Alberta
Memorandum No. 2
Exhibit No.______

MANITOBA AND ALBERTA
Non-Size Related Constant Costs of Crow's Nest Grain, Year 1958
Reconciled With Reported Expenditure, With and Without Apportionment to Passenger Services

		Total		Freight		Passenger	
		System	Grain	System	Grain a/	System	Grain b
A. System Railway Operating Expenses							
System Railway Expenses - 1958		$430,919,006					
Deduct:							
Income Taxes	$19,200,000						
Traffic, General, Communications-Rail, Joint Facility Rents, & Taxes	61,683,433	80,883,433					
System Variable and Constant Cost		$350,035,573		$243,505,666		$106,529,907	
Deduct:							
Substantially Related Grain Lines		2,951,243		2,951,243		-	
Substantially Related Non-Grain Lines		540,052		452,888		87,164	
Size and Geographical Costs		27,719,271		19,283,188		8,436,083	
Accounts 237, 241, 265, 375, 408, 443, 446 and Portions 266/331		2,076,843		469,400		1,607,443	
Variable Operating Expenses		266,725,978		185,550,513		81,175,465	
Total Deductions		$300,013,387		$208,707,232		$ 91,306,155	
System Constant Costs Unrelated to Size or Geography		50,022,186		34,798,434		15,223,752	
Operating Expense Chargeable to Grain at 0.12372			$6,188,745		$4,305,262		$1,883,48[illegible]
Traffic, General, Communications-Rail, Joint Facility Rents & Taxes			849,250		711,387		137,96[illegible]
Grain Constant Costs Unrelated to Size or Geography, Excluding Permissive Earnings			$7,037,995		$5,016,649		$2,021,346
B. System Railway Permissive Earnings							
Permissive Earnings on Road Property Investment		$ 43,142,723		$ 30,970,942		$ 12,171,781	
Deduct:							
Substantially Related Grain Lines		1,392,932		1,392,932		-	
Size and Geographical Costs		5,325,553		3,704,774		1,620,779	
Grain Elevators, Wharves and Other Structures		907,707		631,455		276,252	
Variable Permissive Earnings		13,547,518		9,958,817		3,588,701	
Total Deductions		$ 21,173,710		$ 15,687,978		$ 5,485,732	
System Permissive Earnings on Road Property Unrelated to Geography or Size		$ 21,969,013		$ 15,282,964		$ 6,686,049	
Permissive Earnings on Road Property Investment at 0.12372			$2,718,006		$1,890,808		$ 827,198
Permissive Earnings on Work Equipment at 0.12372			11,171		9,529		1,642
Permissive Earnings on Shop & Power Plant Machinery at 0.12372			13,576		8,583		4,993
Grain Permissive Earnings Unrelated to Size or Geography			$2,742,753		$1,908,920		$ 833,832
C. Total Constant Costs & Permissive Earnings Unrelated to Size or Geography			$9,780,748		$6,925,569		$2,855,179

a/ Represents grain's share of system constant costs if passenger service apportioned a fare share.

Table No. 9
Manitoba-Alberta
Memorandum No.
Exhibit No.___

MANITOBA AND ALBERTA
Size Related and Geographic Constant Costs of Crow's Nest Grain, Year 1958
With and Without Apportionment to Passenger Services

	Group of Accounts	Unit Cost	Adjustment Factor	Adjusted Unit Cost	Size Element Unit	Size Element Item	Total Cost System	Total Cost Grain	Freight System	Freight Grain a/	Passenger System	Passenger Grain b/
A.	Road Maintenance and Depreciation											
201, etc.	Road Maint., Suptec. & Ovhd.	$ 43.92223	1.64255	$ 72.14446	19,742.8	Track Miles	$ 1,424,334					
202, etc.	Track Maint. & Deprec.	742.52000	1.04397	775.16860	19,742.8	do	15,303,999					
221, 266	Fences, Snowsheds & Signs	58.83700	0.98747	58.09977	19,742.8	do	1,147,052					
202, etc.	Road Maint. & Deprec. Associated with Dollars Invested in Tunnels, Bridges and Culverts	0.05745	1.04397	0.05998	$143,098,217	Gross Inv.	8,583,031					
	Suptec., per Dollar of Road Maint.	801.35700	$0.05277	42.04720	19,742.8	Track Miles	830,129					
	do	0.05745	0.05247	0.00301	$143,098,217	Gross Inv.	430,726					
	Sub-total						$27,719,271	$3,429,428	$19,283,188	$2,385,716	$8,436,083	$1,043,712
	General, Rents, Communications-Rail & Taxes						3,467,387	428,985	2,849,876	352,587	617,511	76,398
	Size-Related Taxes						5,443,427	673,461	3,786,774	468,500	1,656,653	204,961
	Traffic						956,814	43,164	461,431	43,164	495,383	-
	Total Road Maintenance Expense						$37,586,899	$4,575,038	$26,381,269	$3,249,967	$11,205,630	$1,325,071
B.	Permissive Earnings on Road Property											
	Gross Property Investment Associated with Miles of Track			$ 12,520								
	Accrued Deprec. at 36.07%			4,516								
	Net Investment			$ 8,004								
	Permissive Earnings at 5.587%			447.18348	11,909.1	West Track Miles	5,325,553	658,878	3,704,774	458,355	1,620,779	200,523
	Total Costs Associated with Size of Plant & Geography						$42,912,452	$5,233,916	$30,086,043	$3,708,322	$12,826,409	$1,525,594
C.	Non-Grain Substantially Related Lines											
	Road Maint.			947.46003	570.0	Track Miles	540,052	-	452,888	-	87,164	-
	Size Related Taxes						157,152	-	131,788	-	25,364	-
	Traffic, General, Rents, Communications-Rail & Taxes						89,299	-	77,775	-	11,524	-
	Total Size Related and Geographic Costs Excluding Substantially Related Grain Lines						$43,698,955		$30,748,494		$12,950,461	

a/ Represents grain's share of system constant cost if passenger service apportioned a fair share.
b/ Represents reduction in grain's constant cost if passenger service bears fair share of system constant.

MR. FRAWLEY: Q. Mr. Banks, would you please now proceed to put your memorandum in evidence by reading it in whole or any such parts as you feel are required to give the Commission a coherent appreciation of the study which you have made on our behalf?

A. Mr. Frawley, at your suggestion I am eliminating from my reading certain portions which I think will not adversely affect the order or the logical sequence of the presentation, and may be unnecessary at this time to refer to in detail.

THE CHAIRMAN: We will leave that to you.

THE WITNESS: Thank you, Mr. Chairman.

This is the third of three studies which were made by the government of Alberta and the government of Manitoba for the purpose of presenting their joint estimates of the cost to the Canadian Pacific Railway of handling Crow's Nest grain in the year 1958. The two previous studies have already been described to you -- the first by Dr. Ulmer, who dealt with permissive earnings upon railway investment; and the second by Dr. Borts who evaluated and corrected certain of the regression models presented by the railway and developed estimates pertinent to the economics of multiple car cuts in classification switching. The study which I made assesses and evaluates the work units required to do the job of moving grain, put these together with the regression co-efficients of the railway which were developed by Dr. Borts, and together, also, with some developed by the railway which we found to be

appropriate in all respects, and it finally developed a cost estimate for the carriage of Crow's Nest grain, and concluded with a comparison which we make between the estimated cost of carrying grain and the revenues received by the railway from this traffic.

Dr. Edwards, a witness for the Canadian Pacific, has stated that the grain movement uniquely lends itself to costing. He has also stated that the nature and characteristics of this Crow traffic "have been utilized effectively to provide a most satisfactory identification of cost with the study traffic".

In our opinion, the unique fitness of the grain traffic for cost analysis to which Dr. Edwards refers is a relative thing. Many costs attaching to grain can be more readily identified than those of other commodities moving in smaller volumes over less clearly defined routes. This cannot, however, be interpreted to mean that costs incurred by the large and complex movement of railway traffic can be quantified with the absolute precision which is customary in the physical sciences.

Since railways are essentially a multi-product industry, characterized by the pervading presence of costs incurred in common for various types and classes of traffic and services and it is impossible therefore directly to assign many categories of such commonly-incurred expenses. Thus, in our opinion, the realistic objective of railway costing is to establish a reasonable identification between traffic

and costs. Grain lends itself to this objective, but despite the volume at which it moves the resulting costs cannot be absolutely identified due to the inherent physical nature of railway technology and the multiplicity of assignments which a railway is called upon to undertake in discharge of its public service obligations.

The second quotation from Dr. Edwards, the one in which he says that the nature and characteristics of the traffic have been utilized by CPR effectively to provide a most satisfactory identification of costs with traffic bears directly upon the study which we undertook by which we have shown that the railway has not attained a satisfactory identification of costs with the grain traffic.

B. Restatement of Revenues

The railway presentation credits grain traffic moving at statutory and related rates to export positions with revenues totalling $35,402,790. This exceeds the amount which can be rightfully attributed to such traffic by $502,836.

I am advised that the rates and charges collected by the railway for extra service required on grain milled-in-transit are not set by statute, and as a consequence are improperly included in a study designed to compare revenues with costs of grain traffic moving at rates so fixed.

MR. SINCLAIR: Would you mind saying advised

by whom? You say "I am advised ..." By counsel? By you, Mr. Frawley?

MR. FRAWLEY: I do not know. If you wish to ask these questions,as you go along -- I would have thought that you might make a note and ask them later. I do not know, Mr. Sinclair. I do not know.

THE WITNESS: Shall I answer the question, Mr. Frawley?

THE CHAIRMAN: It might save time if you did.

THE WITNESS: I am advised by Mr. V.L. Stetchison of the Manitoba Transport Commission to this effect.

MR. FRAWLEY: Q. Would you carry on, Mr. Banks?

A. Accordingly, the 1958 revenue credited to the study traffic by Manitoba/Alberta has been diminished by the amounts collected pursuant to such rates and charges, namely $456,000.

Milling-in-Transit

Consistent with the revenue exclusion I have just described, the switching time associable with milling-in-transit service was identified and removed from the totals upon which our cost estimates are founded.

Proceeding to the discussion of road maintenance expense, as was described this morning, the regression model devised by Dr. Borts to yield estimates of track maintenance, this model does not

explain five-related road maintenance and depreciation expense since statistical analysis of these costs, by both the CPR and Manitoba/Alberta, produced track-mile costs at variance with actual engineering experience as to irreducible or constant track maintenance expense which has been disclosed by extensive investigation of branch line data in the United States.

Accordingly, our estimate of road maintenance is a composite of regression analysis and engineering information.

The size-related cost, which was deducted on a divisional basis from the observations analyzed by regression methods, reflects a magnitude acceptable on an engineering basis, using data publicly available from the Dominion Bureau of Statistics, as well as information supplied by the CPR Engineer of Track. This cost is our estimate of irreducible road maintenance and depreciation expense. It includes provision for tie replacement, bridge and building labor and material, fences, snowsheds and signs maintenance and depreciation, weed control and superintendence, plus an allowance for contingencies. It excludes costs of rail replacement which, at minimal maintenance standards under the most favourable conditions, is governed by action of the elements rather than by any necessity fixed by the requirements of traffic. In this particular respect ties differ materially from rail, since the effect of weather upon the former is substantial, but the effect of weather upon rail is so much less severe that no

basis exists for measuring the full life of little used rail material - even when this was installed in the Nineteenth Century. In other words, engineering experience has not, to my knowledge, assessed the serviceable life of steel rail on a branch line maintained in the absence of traffic. Thus, rail replacement becomes irrelevant to any estimate of irreducible maintenance expense.

I think Dr. Borts discussed the so-called geographical cost with you this morning, but just to supplement what he may have said, I would like to call the attention of the Commissioners and their staff to some of the text on page 92 of the Uniform System of Accounts for Class 1 common carriers by railway which is prescribed by the Board of Transport Commissioners.

We conclude, on these bases, that a reasonable estimate of irreducible size related track maintenance and depreciation costs, at 1958 price levels, is \$947.46, of which \$742.52 is the basic unit cost of road maintenance and depreciation per mile of track. Part of this text illustrates what we mean by costs related to or generated by geography.

This provides that the expense chargeable to, again 202, an account which is designated "track and roadway maintenance", shall include, among other things, the cost of removing dangerous rocks, removing slides, sloping cuts as well as repairs and expenses in regard to maintenance of rip-rap, costs of which are unlikely to occur with any frequency on the Prairies; they relate to mountain territory. In other words, to geography or terrain and not to miles of track as such.

Although model 202C does not explain by regression analysis the variable portion of road maintenance cost incurred by switching service, this can nevertheless be isolated by reference to available data. The 27 divisions analysed by that model exclude the four terminal divisions at Montreal, Winnipeg, Toronto and Fort William. An equation which yields 43.8 per switch engine mile by contrast of comparable cost of 39.1¢ and \$1.20 used by the Canadian Pacific in reconciling regression results with engineering information is not novel. This has been used previously elsewhere and most notably by the Meyer-Stenason-Peck-Zwick co-authors of Economics and Competition in the Transportation Industry. We also found

deficiences in the manner by which Canadian Pacific Railway computed the number of car days by grain in 1958, Crow grain.

The repair, depreciation and earnings expense incurred by freight cars in grain service and a large portion of the results from the number of car days which the car service required is an extremely important part of total study traffic cost which is attributed by the railway and by ourselves to moving the grain traffic. By the original railway estimate these costs and those derived from or those associated with them amounted to $15 million dollars, as revised by exhibit 132. they total quite a bit less than $15 million dollars. Two output units or service units determine their costs; they are car miles and car days. In its original cost estimate the CPR determined steady traffic car miles to be 213,831,000 miles; this remains unaltered. Car days, however, originally estimated by exhibit 64 at 3,385,910 are given as 5,274,358 in revised exhibit 64, which the Canadian Pacific Railway computed. This major modification in a fundamental measure of output illustrates the arbitrary statistical mechanics necessarily involved in the derivation of car days devoted to hauling a commodity such as grain which is carried in cars interchangebly devoted to the service of other traffic as well as grain.

The CPR working papers underlying original exhibit 64 showed that the railway used two quite different and inconsistent methods to compute study traffic car days; one method used for the CPR system as a whole

and the other for grain. It was necessary to develop a system total with which to compare grain so that a portion of repair and depreciation expense and of earnings expense, recorded only on a system-wide basis, could be apportioned to grain. Our analysis determined that if the car day method used for grain was applied to the system, it would more than double system car days. If the system method were to be applied to grain, it would reduce grain cardays by more than half. In either case the result was the same; a discrepancy exceeding 100% in the number of car days assigned to grain.

It is important in assessing our conclusion that the car day accounting method which is described suggest a decrease in the number of car days assessed to grain. It is important to stress that the data shown are described as Active car-days, defined as "all the time the cars were under load plus the time of the related prior empty movement. All storage and repair times have been excluded from active car days." The quotation is from CPR testimony. This definition accords with that formulated by the Cost Finding Section of the Interstate Commerce Commission, which has shaped the understanding of active car days and car day development generally employed in rail cost analysis in the U.S. by regulatory bodies, shippers and carriers. Thus the CPR in the first instance, chose to adhere to a well-known service or output unit - the active car-day- in its development of study

traffic cost estimates.

By its revised estimates submitted with Exhibit 132, however, the railway elected to depart from established practice and to employ a freight car time measurement unit which in its workpapers is designated as a "calendar car-day". In explanation of this, we have been told only "that because of the way grain was handled, this cost should be broken down to cover costs variable with inspections, car days or car miles. This was done by excluding inspection costs amounting to 16% of total repair costs, and developing car days through a special sample of Canadian Pacific cars to determine the idle ratio " Due to its departure from accepted concepts and established practice as to car days, we believe that the burden of proof is on the CPR to justify its untested car day calculation method, which it has not done in the data furnished us.

From the single page of explantory data made available to us, it appears that the key element in the computation of calendar car days charged to grain by the revised CPR estimate is the development of an idle ratio i.e., a method by which freight car time not directly traceable to grain can nonetheless be attributed to it. This idle ratio amounts to 58.14 percent. As a result by the new CPR method freight cars in grain service are apportioned in excess of one-half a day of time unrelated to that service for each 24 hour period directly traceable to it.

In my opinion, this method has several weaknesses

which suggest that it, like its predecessor, may overstate car days chargeable to grain. The first of these weaknesses is separation of CPR from off line car days upon which the new CPR off line car days are accumulated by box cars used inter-changeably for grain and other traffic. Such interchangeability means that grain box cars when in off-line service, for grain or other commodities, are contributing by per diem earnings to the revenues of the company. By contrast, one must infer from the CPR method described that study traffic box-cars, when not devoted to the movement of grain at statutory rates, are necessarily idle. This obviously is not so.

The second weakness in the new CPR car day calculation method is the divorcement of off from on-line car-days, and the apportionment by CPR of idle time entirely to on-line active days. In my opinion what is wrong with it is it ignores the fact that on-line idle time arises from off-line as well as on-line operating requirements and traffic opportunities. Consequently, the derivation and application of an idle ratio based solely upon on-line time, as used by the CPR's new method, is erroneous.

The third weakness which we have found in the new CPR car-day is that the sample from which the data are computed has been described only as "determined from a sample of freight cars traced for a one year period". If this means a CPR freight car sample, rather than box car or grain box car sample it must necessarily include

specialized equipment devoted to the movement of commodities with traffic seasonality quite different from that of grain, such as ores and forest products. Such equipment would have idle characteristics markedly at variance with the boxcars in grain service, which can more readily be shifted to other assignments when not required for grain. Thus a system idle ratio, properly derived, must give substantial weight to the car service requirements of commodities with little or no similarity to the study traffic. By the CPR's revised method, however, the arbitrary separation between on and off-line car days may impute to grain the idle time characteristics of other than boxcar equipment, but withholds from grain boxcars the more favourable car-day count which would result if their active car-days in off-line service were to be considered.

The fourth weakness is an apparent increase in off-line time to provide for cars out of service, but lack of a corresponding on-line adjustment.

The fifth weakness is the ratio of idle to active car-days in the small sample as to which we have records of movement in revenue grain service, equalled only 5.5 percent.

The sixth weakness in the new CPR car-day calculation method is that a check of the small sample available to us indicates that clerical error failed to exclude all days properly designated as "idle" from the computation of active grain car-days. Accordingly,

the 3,208,386 basic count of grain car-days may be correspondingly inflated by the inclusion of some idle days. Since our study days add a factor of least 50, if there are a great many such days it may have some bearing upon the total number of car-days from which costs are paid. Accordingly, the 3,208,386 basic count of grain car-days may be correspondingly inflated by the inclusion of some idle days.

To the six reasons described above we believe that the "calendar" car-day method used by the railway in its revised exhibits may yield results similar to the original method it superseded; it may overstate the number of car-days charged to statutory grain traffic. A more complete appraisal would require elaborateinvestigations of grain box-car idle patterns, non-productive time, and off-line characteristics. In the absence of fuller information we, therefore, have chosen to retain the count arrived at by the most generally accepted and established method and, therefore, our analysis is based upon the original car cost presented by the CPR prior to exhibit 132.

Turning now to freight car repairs we find in looking at the materials supporting the changes made in exhibit 132 that in that respect also the Canadian Pacific Railway have made fundamental changes in the method in which it estimated freight car costs attaching to grain. Originally, the railway followed the well established I.C.C. costing methods.

However, the railways new basis for the development of freight car repair and other costs is open to question for several reasons. It rests, in part, upon a special study made by the United States rail carriers in I.C.C. dockets 31358, C.B. & Q., et al. versus N.Y.S. & W., et al. In our judgment this can hardly lead to accuracy in cost estimating for Crow grain cost to the extent that the railways cost development rests upon the United States special study which includes inspection costs of privately owned cars, for which no adjustment has been made by CPR, as far as we know. The second weakness is the United States study is an average national figure for the entire United States. As far as we can tell this makes it unrepresentative of Canadian operations in which far fewer interchanges occur between competing and connecting railroads. The third is that this United States special study is based upon data originally collected in the year 1947 and it may, therefore, not be suitable for application eleven years later.

I will come to the last weakness we cite on page 15 of our brief. We find erroneous also the denial of credit to study traffic cars for freight car hire accrued by such cars in off-line service which is a characteristic of the CPR car repair cost computation, the method as revised by exhibit 132. But it is equally true that CPR grain box-cars do move over foreign lines and that in such service they contribute what may be a major

share of the $15 million dollars in revenue earned by the railway in this manner during 1958.

As a consequence of the previously described car-count method the car-count traffic would be denied by CPR the beneficial results in time of using grain box cars for other purposes when not required for the movement of grain.

As a consequence of the per diem exclusion, the study traffic is denied the beneficial results in money which accrue from the use of grain boxcars for other purposes when not required for the movement of grain. In short, Manitoba and Alberta find that, by the CPR's revised costing methods, statutory grain traffic is being asked to bear a disproportionate share of total freight car costs, while simultaneously denied an appropriate share of total freight car earnings. Accordingly, we believe that it is improper to disallow to grain, as the railway has done, its proportionate share of CPR's net freight car-hire credit, when grain cars are used interchangeably for other movements.

The foregoing will, when used as a base, yield a more accurate determination of actual expense of this nature and of the cost incurred.

This was treated by the CPR as having 100 per cent long-term variability with traffic. Dr. Edwards has held that, "The number of cars required over any period of time is closely geared to the volume of business handled." This implies that as traffic increases, more cars are needed. However, if the miles per car are increased in response to increasing traffic, this in itself may obviate the need for more cars, and thus negate the theory that car ownership, and hence depreciation, is variable with traffic.

Accordingly, we have conducted our own

analysis of freight car depreciation, the results of which are illustrated by charts I and II. Chart I correlates traffic with intensity of use; Chart II correlates traffic with owned car supply. The charts are at the back of the precis following page 43 -- Charts I and II. Chart I contains a minor error in the descriptive equation curve there shown. That equation now reads y equals minus 1203 plus 14.214857 x. It should read, y equals minus 1181 plus 14.185084 x.

Q. Do you think you should go over this chart at all and discuss it with the Commissioners?

A. The text, I believe, will cover it, sir, and I will be happy to answer any questions that may be asked.

Q. Very well.

A. The page I have just put into the record makes no perceptible alteration in the slope of the trend line and it leads to no amendment whatsoever in the conclusion we draw from Chart No. I, which is that the loaded car miles per car are highly variable with changes in traffic volume. However, if this is true, then we ask, how can car ownership also be related to changes in traffic volume?

In Chart II, the freight car traffic index is related in a like manner to the owned car supply as measured in thousands of calendar freight car days. The number of calendar car days is of course, determined by the size of the CPR freight car fleet as this

varied from year to year over the period measured. Unlike the use pattern shown in Chart I, however, the car-day or ownership pattern of the CPR freight car fleet does not appear to be directly or positively related to traffic volume fluctuations. In fact, Chart II demonstrates how poor a correlation exists between car ownership and traffic volume. It would appear to contradict Dr. Edwards' statement as to a "close gearing" between car requirements and the volume of business handled.

This analysis shows that the long-term traffic growth ---

MR. SINCLAIR: Dr. Banks said if there were any questions on this chart we could ask them, and there was one I would like to clear up: I notice that there is no relationship in here for train speeds, and all the twenties are one side of the slope and all the fifties.

THE WITNESS: What chart are you referring to, sir?

MR. SINCLAIR: Chart I: that is what I thought you were talking about.

MR. FRAWLEY: No, he is talking about Chart II. However, go back to No. I.

MR. SINCLAIR: I am sorry. What I am asking is, would Mr. Banks explain why the twenties are grouped, and the fifties are grouped, and is there any reflection in here for train speeds or car sizes?

THE WITNESS: I will try to answer your three questions in the order they were asked.

The grouping that appears in Chart I results merely from the way that the points appear when they are plotted in accordance with the data available from the Dominion Bureau of Statistics. They reflect no adjustment by us whatsoever. If they fall in a pattern as to a series of particular years, this is simply the result of CPR's experience. There has been no adjustment or change made by us. This is the way the CPR's freight car use is reflected on this chart when properly plotted.

As to train speed, Mr. Sinclair, there is no attempt in Chart I to deal with that variable.

You did ask a third question.

MR. MAURO: Car size.

THE WITNESS: Car size is also not reflected here and the reason it is not may be found in the testimony of Dr. Edwards which I do not have with me at the moment, but if Mr. Sinclair wishes it can be produced for him.

When the period is viewed as a whole -- that is, this 35-year period -- it must be concluded that a substantial increase in annual traffic volumes was experienced during a period when the long-term trend was to shrinkage of the fleet -- to a decrease in freight car ownership. Increased traffic volumes were not accommodated by larger numbers of cars, but rather by more intensive use of the individual equipment

units -- individual freight cars. With a 14 per cent decrease in car ownership in 1958, as compared with the latter years of the twenties, the CPR nevertheless handled a 37 per cent increase in traffic as reflected in its loaded freight car miles.. This reflects the obvious fact that a railroad must maintain a car fleet sufficient to accommodate its anticipated long-term needs, and that all temporarily unused cars cannot be scrapped with each short-run dip in traffic. It is as though a hotel were to contemplate tearing down its two top floors when business became poor.

We believe that this analysis confirms that the car mile portion of depreciation, which reflects intensity of use, does indeed vary at or near one hundred per cent with traffic, as the CPR suggests. It also demonstrates, at least in so far as that single railway is concerned, that the car-day portion of depreciation, which is a reflection of car ownership requirements, is not characterized by direct or positive variability with traffic, as has been assumed by the CPR. Expenses which lack this character must, in the present state of railway cost-ascertainment, be treated as constant costs, which has been done in the development of our cost estimates.

On line haul common costs, a major problem in railroad cost finding relates to the substantial fraction of total cost which, under most conditions, cannot be directly assigned to a particular service or traffic. These common costs stem from the multi-

product nature of the railroad industry, with several services and kinds of traffic typically using the same facilities and/or generating the same units of production. Common costs, such as costs incurred in common by freight and passenger service must be distinguished from costs which can be directly and immediately traced and assigned to a particular transportation job. The expenses of passenger and freight trains themselves are, however, not common, but generally considered to be directly assignable. That is, with minor exceptions, it is possible in almost every case immediately to determine whether a train is freight or passenger and thus appropriately to assign train-related expenses, such as crew wages, or fuel, to freight or passenger service.

A point that is often overlooked is that expenses which may be directly assignable for one purpose, say the determination of freight service costs, become a common cost when the analysis is directed at another goal. Thus crew wages and fuel which are directly assignable to freight service are often incurred in common by several types of traffic, all of which are freight, and such expense must therefore be allocated between the several types of freight traffic when the goal of cost ascertainment is to determine the expense attaching to an individual commodity.

In the case of statutory grain traffic, the expense of grain door installation is an example of

directly assignable cost, and the expense attached to freight train operation in which grain is carried together with other traffic is a common cost, which must be allocated between grain and other commodities carried in such trains. In describing cost allocation generally an eminent American economist, John R. Clarke, has found that "It also offers great opportunities for the development of arbitrary and fictional notions of cost, through the necessity of apportioning items somehow, even if there is no satisfactory scientific basis on which to do it.

The method by which the CPR has attributed to grain its share of line haul common cost is succinctly described at page 2480, Volume 18, of the transcript. The key to this method is: "Constructive train miles used to handle the study traffic were developed based on the average weight of trains on which the study traffic moved weighted by the proportion of the study traffic to total traffic on each train run."

Manitoba and Alberta ask: Is it reasonable to use average weight trains for costing purposes, when large segments of the grain movement are deliberately run as"filler" for time freights? It is already on record that a part of the grain movement is actually handled in solid grain trains, and it is our position that for the computation of grain movement costs such trains represent a more reasonable point of departure than cost computation based on average weight trains.

We believe this follows from the fact that average weight trains reflect a tonnage reduction for manifest freights to permit them to achieve schedules and speeds required to service other traffic, but not required for the movement of grain, which can as well be serviced in so-called "drag" or full-tonnage freight trains. The influence of such manifest freight tonnage reductions upon a composite train-weight figure leads to higher unit costs. Consequently, if line haul common costs are computed on the basis of average weight trains, the resultant higher unit costs impute expense to the grain movement which actually arises from the service requirements of other types of freight traffic.

We are not proposing that the railway policy of using grain as fill-out for manifests be changed. By this practice the unit costs of such trains are reduced, and there is no offsetting disadvantages of which we are aware to the grain movement, but we do suggest that a cost calculation reflecting this operating practice is an erroneous approach to the present study, in as much as mechanical computations of actual average operating costs ignore the very important fact that this aspect of operating policy, namely, the weights of trains which actually move over the line, is a reflection of practice which is designed for the convenience of the railway itself and for the convenience of other kinds of traffic, not for Crow grain, and therefore does not reflect the inherent operating

requirements and the apparent costs of the grain movement.

Consequently, to determine that portion of the line haul common costs which is an inherent cost of the grain movement, we have computed on the main line train movements constructive train miles based upon the assumption that grain is handled in solid trains as its volume often justifies over the eleven main line subdivisions of the CPR, Alyth to Vancouver and Moose Jaw to Fort William.

--- A short recess ---

THE CHAIRMAN: Order, please.

I think before we proceed I should say that when we adjourn this evening, we will convene tomorrow morning in the Board of Transport. The room is available, and likewise on Monday. But on Tuesday and Wednesday we have to come back here and then on Thursday and Friday we go to the Board of Transport Commissioners.

Mr. Frawley?

MR. FRAWLEY: Q. Mr. Banks, you were on page 22 of your memorandum, item 7:

"Train other expenses -- Account 402".

A. Yes. Account 402 is perhaps the least useful for costing purposes of any single account to be found in the prescribed and uniform system of accounts. Professor White Laird, of the University of Western Ontario, in his book entitled "Cost data for the Management of Railroad Passenger Service" describes this account, and I quote him, as the "Garbage Can Account". By this he means that it contains expenses of all types and descriptions completely unrelated one to another -- such things as fuses and sawdust are found there side by side with brake hose and perhaps a hundred or more other items of every type and description that may be required for operation of the Railway.

Therefore it is a very hard account to use for costing purposes. However, it does include among many other items in it grain doors. In its development of such cost the CPR used an average of the annual expense incurred for grain doors during the three-year

period 1956, 1957, 1958. Our study disclosed that grain door expense so closely reflected traffic volume in each year that the use of a three-year average was unlikely to yield a better estimate of such expense, and we therefore used 1958 actual grain door expense rather than the three-year effort.

The great variety of services and supplies represented by the remaining charges in account 402 required an apportionmet to grain which was originally accomplished by the CPR on a system average basis. In the restatement embodied in Exhibit 132, however, the railway adopted a different method. I now turn to page 23. The data furnished by the CPR indicated that fundamental to its new method was a separation of prairie and Pacific region costs from system totals. Western unit costs were now apportioned to grain instead of the system averages formerly used. This method appears to be an improvement and indeed we so believed until we examined it more closely, and then we found unfortunately that it produced several flaws which, lacking further explanation, appeared to make it unreasonable for inclusion in our cost estimate development. These flaws were, first, by the CPR's new method of apportioning expenses to be found in account 402, 76 per cent of the freight portion of what is described in CPR's working papers as "other train expense", which include total charges in this account less solely related passenger expense,

grain doors and lubrication costs, 76 per cent of the remainder of the charges in the freight portion of the account is charged against the west, although that area was serviced by only 56 per cent of the 1958 system freight train miles.

There may be an explanation for this, gentlemen, but we do not know what it is.

Another reason -- skipping (b), which merely expands upon the same sort of thing I am talking about -- the unit cost of "other train expense" which follows from what is described in (a) above as thus computed by the CPR was 17.8 cents per 1958 freight train mile in the west, but the same kind of expenditures in the east was only 8.1 cents.

Again, we do not know why this might be.

Another reason why the new CPR method is not acceptable for our study is that Account 402 also includes, among many other things, the cost of heating, icing and refrigerating services. None of these that I have specifically mentioned are incurred on behalf of grain, but they were not deducted from the Regional expense prior to the apportionment to grain.

As a consequence of the combined effects of these and other factors, the restatement of train other expenses in exhibit 132 appears to create a cost disparity between east and west operation which seems unjustified by any facts known to Manitoba/Alberta.

8. Loss and Damage.

CPR originally used 1958 claim loss and damage claim as a point of departure for its calculation of such cost. However, in Exhibit 132, "to make consistent with other parts of study", the average of claim payments experienced during the three-year period 1956-57-58 was substituted for the previous data. This had the incidental effect of increasing such costs, although prior to such adjustment they were already at a level roughly 50 per cent above that experienced by the CNR, which as I recall has older freight cars by which the loading presumably would be more subject to loss and damage.

MR. SINCLAIR: I wonder if I might -- seeing that I would like to make a note of this, I thought that that inquiry was answered. It was raised previously, and the explanation, as I recollect, that was given, was that these figures were not comparable (CN-CP figures) because the CPR figures included administrative costs associated with claims, and the Canadian National did not have that data to separate that out. Does the witness say that he recalls that explanation that was given in this proceeding, I think to the Commission -- I think it was given at a request when Mr. Stenason was on the stand and/or Mr. Bandeen, or the combination of both of them, during the proceedings when this same point was raised, and I was wondering if this is something more we are being asked for or has that been overlooked?

MR. FRAWLEY: Are you saying that specific

inquiry was answered in the course of somebody's evidence?

MR. SINCLAIR: My recollection was that it was. I was wondering if there was another specific inquiry, or has it been overlooked that this question was asked and disposed of.

MR. FRAWLEY: Q. To whom was your inquiry directed, Mr. Banks?

A. To Mr. Stenason.

Q. By letter?

A. As far as I can recall, it was only verbal, and I think Mr. Sinclair is quite right, that the matter was discussed at the May hearings of the Commission. However, it was not clarified to the extent of enabling us to judge what the possible explanation might be.

In any event, we will certainly check what Mr. Sinclair has told us, and ---

MR. SINCLAIR: This is a matter that I could suggest could be cleaned up at this conference we are going to have.

THE CHAIRMAN: Yes.

MR. FRAWLEY: I think we would not have to convene that conference to answer a matter of this kind.

Q. Would you continue, Mr. Banks?

A. In any event, our studies incorporate the original loss and damage cost because it was our intent to use 1958.

Going to page 25, the middle of the page,

dealing with yard switching.

From what we know of the workpapers developed at the intermediate and terminal yards, we think it likely that the railway has overstated the costs incurred by grain switching because

(1) CPR has failed to deal with the significant factor in switching costs, namely, the tendency of averages to conceal the work which is actually done. Not only has the CPR developed average costs at some yards, but it has combined switching averages in a way which uses averages of averages to arrive at further averages.

Giving an example of this, the CPR made yard studies at Kenora which developed by its method that the switching time per through load car at Kenora was 1.1 minute. In the same period of yard studies it developed comparable costs at Swift Current of 2.1 minutes per car, and at Revelstoke of 1.5 minutes per car.

The simple average minutes per through loaded car at these three yards is 1.6, and this figure of 1.6 switching minutes per through loaded car was then applied by CPR to all through loaded cars at ten other yards, including, among others, Brandon, Saskatoon, Lethbridge, Medicine Hat and Kamloops.

Regrettably, since we had only CPR data available, we have had to do the same, but we have endeavoured to recognize the

weakness of averaging in assessing switching operations.

Dr. Borts has previously described how we have dealt with this procedure and how we have tried to make a point that every switchman knows: that big cuts make faster switching.

The second major error that we found in the CPR treatment of yard switching relates to the fact that the railway apparently charges grain with certain elements of switching which were not in fact performed for grain traffic.

And the third error relates to what we believe to be erroneous computation and application of the winter switching adjustment.

Our initial step in the endeavour to try to find reasonable switching costs for export grain relates to the development of accurate switch engine time requirements for the service of through cars at those main line yards where no tonnage adjustment is normally required for through freight trains, i.e., at Kenora and for eastward train movements at Ignace and Field. In those yards, the CPR study has assumed that all through grain cars are "classified." This is another instance where averaging is used to distort grain costs, since a large number of grain cars travelling in the direction I have indicated requiring virtually no switching are averaged with relatively few grain cars on local traffic and other cars requiring a great deal more switching. Total

time is averaged against all cars passing through yards, but the work is done for the local cars only. Inour view this is inaccurate because classification is authoritatively defined as "train make-up and break-up", and this is obviously not required for car traffic which is pre-blocked on trains which have left a subdivision and are about to proceed on another with an equal or greater tonnage rating.

Going now to page 27 ---

MR. SINCLAIR: When you are talking about train movements you mean empties?

THE WITNESS: Yes, sir, we mean empties.

Going to page 27 now, if we use the CPR data as to the number of grain cars passing through these yards during the study period, which we did do, we then applied as appropriate the switching time per car developed for Kenora, including the limitations in such a procedure but for the same reason, which bound the work we did, namely the lack of completely suitable information. However, since a tonnage adjustment is here also necessary, we added, at these other six yards, a factor for tonnage adjustment which is not included in the development of our switching time at Kenora.

Correction of the third apparent defect in the CPR yard studies relates to the weight attached by CPR in Exhibit 132 to switching under winter conditions. It should be brought out, perhaps at

this time, that prior to Exhibit 132, the CPR cost estimate understated the costs of switching because it included no adjustment for switching. The railway, however, corrected this in Exhibit 132. However, in so doing they used a method which rests upon the assumption that grain traffic flows at an even volume throughout the year. The fact is, however, that only 24 per cent of the grain cars unloaded at the export positions were handled during the four winter months of December, January, February and March, 1958. If this seasonal slack is taken into account, the so-called "winter adjustment" is reduced from 5.1 per cent to 3.7 per cent (15.3 per cent x 24.35 per cent) of winter traffic.

MR. SINCLAIR: Do you mean unloaded? Is it based on unloads rather than terminations? Did you use unload as ---

THE WITNESS: We mean unloaded.

MR. SINCLAIR: Through the elevator?

THE WITNESS: We mean unloaded, Mr. Sinclair.

MR. SINCLAIR: I guess you have not heard of demurrage.

THE WITNESS: In my judgment the attempt made by the CPR to measure the maintenance and transportation expense and permissive earnings incurred by the movement of export grain was not pursued with equal vigour in the area of its traffic, general and miscellaneous expense.

Manitoba/Alberta appreciate the problem faced by CPR in the apportionment of these indirect expenses. We believe that any method evolved for the purpose must , in the present state of rail cost analysis be rather more than less arbitrary. At the same time we believe that we have developed a method of apportioning these expenses which approaches more closely to the facts of the matter than that which has been used by the railway. To this end, our analysis embodies several departures from the CPR method yielding results such as are shown in exhibit 68 (revised). We have adjusted the CPR's passenger freight separations in certain accounts , No. 247, operation of rail and 468, railway tax accruals and have developed and/or applied methods

other than that used by the railway to apportion tracks, traffic and communication rail expense. Finally we have computed these costs in two ways, firstly, so that their constant portion is entirely attributable to freight service, and also, for comparison, so that an appropriate portion of fixed cost is borne by passenger (including commutation) service. Our adjustment was limited to taxes and to the maintenance and operation of rail communications, CPR, to ~~the extent~~ to which a share of the cost of CPR Bankok office is of CPR methods apparent to Crow grain traffic. The CPR separates the latter on a train hour basis, which in my opinion tends to place an unduly heavy burden on the freight service, since separation on such a basis implies that the paramount use of communications is for control of train operations, with no weight whatsoever given to the extensive communications requirements for other transportation purposes, for maintenance of road and equipment, for general superintendence and for traffic solicitation and service. Inasmuch as the separation formula used by the I.C.C. reocgnizes these other burdens on rail communications networks, we have adopted and applied it to CPR's total Communications-Rail Expense, in 1958.

A share of the freight portion of traffic expense was apportioned to the export grain movement by CPR in a conventional manner, which is to say, in the proportion which grain transportation, maintenance and earnings variable expense related to system total

freight variable expense in these categories. This convention is adopted, by CPR and others, simply because available data do not lend themselves to more refined methods. Likewise the development of improved data through special time and supply use studies directed to the personnel and material expense in these accounts are deemed infeasible for various reasons. There is already of record, however, extensive testimony demonstrating the inapplicability of conventional methods of apportioning traffic in general and costs of this character to the movement of Canadian grain to export positions. In the light of the facts disclosed by this testimony and the statutory status of grain freight rates it is obvious that certain normal traffic department activities are here precluded. We have therefore allocated to grain that portion of freight traffic expense which corresponds to the ratio between grain revenue and total system freight revenue.

MR. SINCLAIR: You mean as proposed or in effect.

THE WITNESS: We are describing what we have done in our development of cost estimates.

Non-income tax accruals were charged by the CPR against the studied traffic in the same manner as traffic expense. Our departure from their method involves an analysis of such taxes by their nature, and assignment or apportionment as seemed reasonable in view of the information we possessed. I think we can profitably omit the details of our procedure and

go over to page 32.

MR. SINCLAIR: I have a note here that I was requested during these proceedings to prepare a memorandum with regard to taxes and I have not filed it with the Commmission. The data and the material was turned over to Mr. Stenason and I can at some time maybe put it back but I wondered if that cannot always be looked at in the conference.

THE CHAIRMAN: We are looking for a lot at the conference.

MR. SINCLAIR: It may save a lot of putting down ---

THE CHAIRMAN: The Commission expects a great deal from the conference.

MR. SINCLAIR: These are unemployment insurance and business and all those things.

MR. FRAWLEY: Tracks per mile of road in Alberta, that is all going to be in?

THE WITNESS: With the techniques presented in this study, two alternate methods of constant cost determination are available. Neither of these is preferable in itself, and each poses problems for the cost analyst. Once a determination of such cost is reached by either method another profound and unsolved problem has to be faced, namely, their apportionment among various categories of traffic. By any method thusfar evolved, this is accomplished in a necessarily arbitrary manner.

The other day while rummaging through some

old papers I came across a discussion of this problem which I would like to read to you gentlemen. It says:

"The apportionment of constant costs over the traffic on a 'cost of service' basis is, of course, a philosophical impossibility. If these costs bore any relationship whatsoever to the volume or character of the traffic handled, a necessary condition to any rational cost apportionment, they would not be 'constant'. Rather, the constant costs represent an indivisible whole insofar as the cost of producing the services are concerned. Any apportionment must of necessity be arbitrary and arbitrary apportionments here would have little more economic significance in the fixing of the correct level of a rate than they would in establishing the price of packing house products. The only recourse is to 'demand' considerations."

THE CHAIRMAN: Whose words are those?

THE WITNESS: Those are the words of Dr. Ford K. Edward, Institute of Industrial Transportation and Traffic Management, American University, School of Social Science and Public Affairs in Washington, D.C. on January 27, 1954.

MR. SINCLAIR: I think he said something somewhat similar when he was giving testimony.

MR. MAURO: I think so, on cross-examination.

MR. SINCLAIR: Well, if my friend wants to argue it now, he can.

MR. MAURO: We will argue the case later.

MR. SINCLAIR: I do not think it was in cross-examination.

THE WITNESS: The basic method employed by the CPR (aside from the specifics of its application) in which constant cost is apportioned between grain and other traffic in the ratio of grain variable to total freight variable cost is neither more nor less arbitrary than other methods which could have been used. Had the CPR's apportionment of constant cost been accomplished on a ton and ton-mile basis, in accordance with established Interstate Commerce Commission practice, the results would, of course, have been more unfavourable to grain than the numbers which the railway chose to advance; they would, however, have been no more meaningful.

To provide an indication of the variety of results attainable by means of different fixed cost apportionment methods, we have prepared several analyses of such costs which are developed in accordance with the two alternative methods mentioned above. In their application we have in some cases, put the entire burden of system fixed cost upon the freight service, as did the CPR, and in other cases we have made adjustments to arrive at more appropriate results, as described below. In all, Manitoba/Alberta

have developed six patterns for apportionment of constant costs, as follows:

1. Based on regression equations, without apportionment of constant costs to passenger service;

2. Based on regression equations, with apportionment of constant costs to passenger services;

3. Reconciled with reported expenditure, without apportionment of constant costs to passenger services;

4. Reconciled with reported expenditure, passenger services bearing an appropriate share of constant cost;

Size related and geographic Constant Cost.

5. Without an apportionment to the passenger services; and

6. With an apportionment to passenger services.

Then going to page 34 to areas of imprecision. The constant and variable costs developed in the manner described above, when integrated with those CPR cost coefficients which have been properly computed are believed to provide an improved measure of the movement cost of export grain during 1958.

Our study however, also indicated other areas which seem to warrant additional research if greater precision is deemed desirable in assessing statutory grain movement costs both past and prospective. These points are, first, the fact that there is the CPR and our own study in the estimates of

the number of track miles which are substantially related to grain and I use the word "substantially" throughout in my testimony rather than "solely" because it does appear that the word "solely" would apply as far as we can tell to only two of the many branch lines which carry a good deal of the grain traffic. I have here a CPR work paper entitled "Statement showing Revenue Ton Miles, Grain, Total Revenue 50% Non-Grain, Total Net Ton Miles and Percent Grain Net Ton Miles to Total Net Ton Miles for solely Related Branch Lines." This last column on this work paper which is entitled "Percent net grain ton miles to total net ton miles" is the one of significance in considering the use of the word "solely". There are on this sheet data given for such subdivisions as Arborg, Vancoe, Arcola and Cassels, among others which have respectfully the following percentages of grain net ton miles to total net ton miles -- 36.8.

THE CHAIRMAN: That is for Arborg?

THE WITNESS: Arborg.

MR. SINCLAIR: These were all put in evidence when Mr. Stenason was here.

MR. MAURO: They are in evidence and he is using them.

MR. CUMMING: I do not recall it was given a number but I have a recollection of Mr. Stenason giving the figures.

MR. MAURO: It was in my cross-examination.

MR. SINCLAIR: I think we supplied the paper to him through you.

MR. MAURO: He is using it.

MR. SINCLAIR: There is some explanation in re-examination too.

MR. MAURO: Q. All right.

THE WITNESS: 69.1%, that is Miniota; 62.2% for Arcola; 59.2% for Colonsay and 62.9% for Cassels. Now, I have ticked those branches which represent the extremes of what I consider to be the misuse of the term "solely". Most of the grain carrying lines range upward from 75% to 100% but there are only two lines that are solely related in the basic meaning of that word, that is, they carry no other traffic on these lines except these two.

THE CHAIRMAN: You use the word "substantial"?

THE WITNESS: Yes, sir.

MR. SINCLAIR: What is the mileage on Arborg on that sheet?

THE WITNESS: 36.8.

MR. SINCLAIR: I want to call to the attention of the Commission ---

THE WITNESS: I beg your pardon, the mileage is not on the sheet, we put it on and it is 74.3.

MR. SINCLAIR: And it was only a portion of it that was solely related and taken in the computations in the whole subdivision, which, of course, includes Stonewall to Winnipeg which was discussed so, therefore ---

THE WITNESS: The mileages on the other subdivisions, as long as they have been brought in, are Mineota 43.8.

MR. SINCLAIR: I am suggesting you have to have a mileage that has been taken as solely related although the percentage of grain over the whole subdivision can quite well be low, on a line that is solely related it might be high.

THE WITNESS: The information given to us indicated that the Arborg subdivision was the only one that I can recollect where the complete subdivision was not solely related.

MR. MAURO: That is in the evidence also.

A. Arcola was 96.7 miles; Colonsay was 108.5 miles and Cassels 23.2 miles. In any event, I bring this matter up only to indicate to you that we do not use solely related, we think only two of these lines are solely related and in any event it is appropriate to state at this time for the record that Manitoba and Alberta in the interest of conservatism have assumed the concept advanced by the CPR as to expenditures on such a substantial validity of this concept. In our opinion its validity has to be shown.

MR. MAURO: You had better underline that because we will be saying plenty about it.

Another probable overstatement embodied in both the CPR study and our study relates to the train switching costs which is described in more detail at pages 36 and 37 of my precis.

The third type of probable overstatement relates to transitional costs in dieselization, costs which will not recur in the future.

Another type of overstatement relates to the possibility of a fixed element in the road engine maintenance costs which we have treated as 100 per cent variable with the traffic, just as the CPR has done.

Another type of imprecision inherent in both of these studies is the probability that future yard costs will be reduced at some CPR locations. This may not be appropriate to cost development for the year 1958, but it is appropriate for the determination of future policy to consider the impact upon cost of operating improvements currently taking place on the CPR. As to these, Railway Age, which is the authoritative trade journal, reports:

> "Canadian Pacific will install CTC for train movements through the Winnipeg terminal area, with the two-way radios on yard engines, the railway estimates that crews will be able to spot cars at customers' sidings in half the time now required, and all traffic will move through Winnipeg 30 per cent faster."

The Manitoba/Alberta study has employed many cost components and coefficients developed by the CPR.

For example, if you turn to Table 1 attached to the precis of my evidence you will find unadjusted unit cost for account 201, road maintenance superintendence and overhead as being $0.03288. This is identical with the unit costs shown in the CPR revised exhibit 63. We have also used on this same table unit costs identical with those employed by the CPR for accounts 227 and 266; for accounts 231 and 266; for accounts 249 and its share of 266; and for account 275, etc. The same thing can be said about the other tables showing the development of our cost estimates. We have employed CPR costs very extensively amending these only where they seemed to require corrections for purposes of greater accuracy.

Consequently, we have leaned heavily although not exclusively upon data which the railway provided. We have directly assigned some costs, apportioned others, and used regression results as seemed appropriate. Our findings represent a research effort of substantial proportions, by which the provinces have satisfied themselves that the CPR cost study contains numerous overstatements. So numerous are these, and of such magnitude, that they have attached to the grain movement a deficit stigma which it does not merit.

Manitoba/Alberta find that 1958 revenues from the movement of statutory grain to export positions,

far from imposing a burden on other traffic or upon the Canadian Pacific's general financial position, do in fact cover grain's variable movement costs fully and also contribute $585,910 to the fixed costs of the railway's plant.

Q. And that figure appears on page 42 in the table there, extended?

A. The difference between the revenue from Crow's Nest grain traffic and the sum of variable plus an apportionment of constant cost will be found to be in a range of from $9.8 million to $14.4 million when related to 1958 operations. This shortfall from total cost coverage is believed to be a characteristic of the revenue contributions made by many commodities other than statutory grain which move on the railways in Canada. Manitoba/Alberta therefore find no substance to the theory that the Crow's Nest Pass rates represent an inequity in the Canadian railway rate structure.

The details of our cost estimates are found at page 42 and in the tables which follow my precis.

Thank you, Mr. Commissioners. That completes my prepared statement.

Q. You have nothing of an extemporaneous nature to add to what you have read?

A. No, sir.

MR. FRAWLEY: Thank you very much, Mr.Banks.

THE CHAIRMAN: We will adjourn now until ten o'clock tomorrow morning when we will have Dr. Ulmer.

---Adjournment.

I N D E X

NO EXHIBITS IN THIS VOLUME

ROYAL COMMISSION ON TRANSPORTATION

Proceedings of hearings held in the Court Room, Board of Transport Commissioners Offices, Ottawa, Ontario, on the 11th day of October, 1960.

COMMISSION

Mr. M. A. MacPherson, Q.C.	Chairman
Mr. H. Anscomb	Member
Mr. A. H. Balch	Member
Mr. R. Gobeil	Member
Mr. H. A. Mann	Member
Mr. A. Platt	Member

COMMISSION COUNSEL

Mr. A. G. Cooper, Q.C.

Mr. G. S. Cumming

Mr. H. W. Ellicott	Adviser
Mr. F. W. Anderson	Secretary
Major N. Lafrance	Assistant Secretary

Ottawa, Ontario,
Friday,
November 11, 1960.

--- On commencing at 10:00 a.m.

THE CHAIRMAN: Order, please.

MELVILLE J. ULMER, recalled.

CROSS-EXAMINATION BY MR. SINCLAIR:

Q. Dr. Ulmer, you are aware Canadian Pacific is prescribed by law under the Uniform Classification Account to report to the Board annually its net rail investment?

A. Yes, sir.

Q. The net rail investment of Canadian Pacific determined by the Board of Transport Commissioners and in accordance with that determination and the classification prescribed by the Board, the net rail investment in Canadian Pacific at the end of 1959 was 1 billion, 427 million, 676 thousand, 210.

A. Yes, sir.

Q. You are not challenging this net investment in the rail of Canadian Pacific?

A. No, sir.

Q. You agree, Dr. Ulmer, that the investment in the Canadian Pacific rail enterprise was made in the pursuit of legitimate business objectives by a reasonably prudent management?

A. Yes, sir.

Q. In determining what you contend are reasonable permissive earnings of the rail enterprise of Canadian Pacific, you first apportioned the fixed interest securities on the basis of investment, rail versus non-rail, and by following this method you made no attempt to determine the reasons underlying the issuance of the debt securities; that is correct?

A. That is correct.

Q. Now, for example, under your method a part of the 30 year collateral trust bonds ---

A. Yes, sir.

Q. --- three and a half issued November 1, 1944, due 1974, in United States securities has been allocated and placed against the rail enterprise of Canadian Pacific; correct?

A. Yes, sir.

Q. I suggest to you, Dr. Ulmer, that this entire bond issue was in fact issued to take care of an obligation to Canadian Pacific in respect of an asset that is under the Board's classification wholly non-rail, and as a result of your method and as a result of assigning a part of that 30 year bond issue which was made for non-rail purposes, you have, of necessity, assigned not only non-rail to rail but rail to non-rail?

A. May I respond to this?

Q. Certainly.

A. I have found that really it is rather

fruitless in a corporation as complicated as yours is to attempt to trace down a particular dollar that has been borrowed for presumably a particular purpose. Assuming that a corporation does borrow money for some purpose and uses it for this, as I am sure yours did, the very good it does, if nothing else, is that it releases other funds at the corporation's disposal which it may use for another purpose. I hence believe it makes more sense to distribute the fixed charges in the manner I did than attempting in this other way to trace down each particular dollar that the corporation borrows.

I should say, too, that my distribution of fixed charges comes out to almost exactly the same thing as your Mr. Smith's distribution of fixed charges.

Q. You say my Mr. Smith. Mr. Smith appeared before this Commission and gave evidence, but the distribution Mr. Smith gave was not his distribution but the distribution of the Board of Transport Commissioners.

A. Yes -- so mine came out to exactly the same.

Q. You knew that?

A. I had presumed so.

Q. You had presumed so?

A. Yes, sir. He does not say.

Q. He does not say?

A. Not that I can recall.

Q. Well, you could have, I suggest to you,

by inquiry have ascertained that before the distribution of fixed interest securities was made by the Board of Transport Commissioners their financial advisers made a most intensive study and allocated directly where that allocation was possible. Did you know that?

A. I cannot say that I knew that. I will say that it does not make any difference in practice whether his method is followed or my method is followed because we come out with the same fixed charges attributable to rail.

Q. Well, we will see about that later.

Did your counsel show you this letter I wrote to him of July 18, 1960, in which a request was made by him and other counsel for the basis of fixed charges apportionment. Did he show you this? Have you seen this before?

A. No, I do not think I have seen that.

Q. I refer the Commission and the witness to my letter of July 18, addressed to provincial counsel, copy to the Board, pursuant to their request in which this is stated -- you might read it with me:

> "Fixed charges, with the exception of the interest on perpetual 4% consolidated debenture stock, are directly allocated to rail and non-rail. Interest on perpetual 4% consolidated debenture stock is apportioned on the ratio of net investment in rail and non-rail".

Mark that, would you -- "net investment".

"This formula is that used by the Board of Transport Commissioners since this judgment of September 20, 1949, and followed by it in subsequent judgments; for example, specific reference to the adoption of the formula is made by the Board on page 14 of its judgment of March 1, 1950."

That was not brought to your attention?

A. No, that was not.

Q. Now, in your apportionment of fixed interest securities, rail versus non-rail, you used gross investment

A. I did, sir.

Q. And did you know that the Board used net investment, rail and non-rail?

A. No, I cannot say that I did. Again, I am not sure that it makes any difference; in fact, I am rather sure it does not make any difference.

Q. Now, we will just see.

I suggest to you that the reason the Board used net investment was to properly reflect the depreciation accruals of each group of bonds, rail and non-rail, which is not possible under your method?

A. Yes, sir. Of course, this is a proportionate allocation, and it would have to be true that a proportionate allocation based on a gross investment concept is different from the one based on a net investment concept.

Q. Quite right.

Now, Dr. Ulmer, under your approach to what would be reasonable permissive earnings on equity capital, you took 1959 net earnings after fixed charges rail and non-rail; correct?

A. Yes, sir.

Q. The fixed charges deducted were as calculated by you on the basis I have discussed?

A. Yes, sir.

Q. You will agree, therefore, that any error in your approach on fixed charges also affects the calculation of earnings, rail versus non-rail? This necessarily follows?

A. Well, I hesitate at the word "error", because I am not at all convinced that my method is not as good as any other one that might have been adopted.

Q. Well, any difference that results from a method you follow by taking gross investment and by not looking behind to see what the debt securities were issued for necessarily disturbs the relationship of rail and non-rail and the separation made by the Board?

A. Any difference in method in allocating fixed charges would affect the allocation of net earnings, yes, sir.

Q. In your table 2 you made reference to annual average earnings 1957 through 1959?

A. Yes.

Q. You said on page 2 of your paper that

-- and I am quoting you:

"These earnings are distributed between rail and non-rail in accordance with the Board of Transport Commissioners classifications".

A. Yes, sir.

Q. Now, taking 1959, therefore, I suggest to you that you did not follow the Board's classification in arriving at rail and non-rail earnings; and, in fact, you have credited to non-rail earnings which under the Board's classification are rail specifically, express and 'barge' services in British Columbia. Did you know that?

A. I will say that I took these reports of earnings from the reports of your company files with the Board of Transport Commissioners, and presumably in accord with their regulations. In fact, I am sure they were in accord with their regulations.

Q. Well, I have the report here, and I am going to suggest to you that you did not do that, and you yourself said that you did not do that on table 2. If you will look at the source of table 2, you have a mixture of corporate report and Board report. You have shown that right on the footnote to your table 2.

A. Yes, sir.

Q. Did you know there were differences between corporate reporting and what was required under the classification; did you know that?

A. Oh, yes.

Q. You knew that?

A. I did know that.

Q. Well then, when you were saying you were making it in accordance with the classification of the Board in the determination of rail earnings, why did you not take all your figures from the one source? Why did you take part of your figures from this report and then take the other figures from the corporate report?

A. I believe that I took my figures from the report to the Board of Transport Commissioners and then noted that some of them agreed with those included in your annual report, and hence cited it.

Q. By doing that, you got a lower figure for rail earnings; did you not?

A. I did not believe that I did, no, sir.

Q. Well then, why did you not take the figure shown on the Board report that you started to work from?

A. It is my understanding that I did.

Q. Well, you could not have, I suggest to you, because the figures are different. Your base figure is from the annual report to the shareholders and your calculations are from the Board's report pursuant to the classification.

A. I am not sure what you mean as the base figure and the calculated figure.

Q. Well, you take a figure for railway and add to it the additions to railway to make rail?

A. Yes.

Q. And you take the railway figure from one source and the adjustment to the railway figure to get at rail from another source; correct?

A. My memory is that I took both these figures from the report of your company to the Board of Transport Commissioners.

Q. You think you did. Will you show me on your calculation where is express, how did you get express earnings CP assigned to rail, how did you do it? Is that from the report?

A. My memory is that I took this total rail figure from your company's report to the Board of Transport Commissioners.

Q. And then you added other income rail?

A. No, the total rail figure is $31,200,000 here.

Q. But I suggest to you the only figure you took as your base figure ---

MR. FRAWLEY: If I may interrupt. Dr. Ulmer examined these figures in Washington in Mr. Banks' office, I think.

THE WITNESS: That is true.

MR. FRAWLEY: And if the witness is generally without memory and these papers not being here -- as I understand these papers which you looked at in Mr. Banks' office were stockholders' reports or reports to

the Board?

MR. SINCLAIR: I do not know why you interrupt at all; I am asking him on the basis of his own Table 2, and showing him what he necessarily had to do.

MR. FRAWLEY: I think the witness said, "I think" and "As I recollect I got this figure from such-and-such report." Now, if the witness wishes we can have that verified by making a telephone call to Washington.

MR. SINCLAIR: Is it not amazing that a financial man would come up without some working papers when I made it abundantly clear the day before yesterday the line on which I was challenging his evidence?

MR. FRAWLEY: The day before yesterday this gentleman had left Washington. It is obvious he has come here without these reports which Mr. Banks possessed himself of,and also the stockholders' report for the year-long study.

THE CHAIRMAN: We do not want to reflect on witnesses here.

MR. FRAWLEY: And in any event ---

MR. SINCLAIR: The word "absurdity" was used by this witness and I will show where the absurdity lies.

MR. MAURO: That is an insult to this Commission.

THE CHAIRMAN: We do not want any absurdity between counsel.

MR. MAURO: When counsel says what he is going

to say ---

MR. SINCLAIR: I still say I am going to show where the absurdity lies.

MR. FRAWLEY: I am only concerned at the moment with whether or not it becomes material for the witness to give a proper answer than "I think", "I took it from this or that book". It is easy to determine. It can easily be checked by a telephone call.

MR. SINCLAIR: Q. Why did you not take it all from one source, why did you put in two sources?

A. I have already answered that.

Q. How?

A. I said I took it from the annual report of your company to the Board of Transport Commissioners.

Q. I suggest to you you have made no adjustments at all for express and that if you look at Schedule 66 I think you will see that the figures cannot agree with that. I suggest to you what you did was take your base ---

A. Is this your figure here?

Q. Just a minute, you then took Schedule 66, made calculations in here, added this to this and left out, by the very nature of things ---

THE CHAIRMAN: You are showing the witness the Board of Transport Commissioner's Report.

THE WITNESS: Yes.

THE CHAIRMAN: It does not ---

MR. SINCLAIR: Q. There is a ---

A. I am amused because it looks to me as though the omission here is exactly $300,000 which in my calculation for the purposes for which this report was written was absolutely, thoroughly, insignificant. I would like to say one other thing: I never was -- you are reading my mind as to what I did and I never saw a report of this kind at all.

MR. FRAWLEY: If you ask Mr. Sinclair to take the book in your hands I am sure he will let you.

MR. SINCLAIR: Q. What does this mean?

A. I shall tell you exactly what it means. I received from my friends here in Washington ---

Q. This is Ottawa.

A. I received from my friends here in Ottawa reports compiled by several accounting firms and our study in this report, these figures, were taken primarily from the report of your company to the Board of Transport Commissioners. This was my source.

Q. Well, this is a report. This is it right here, this is the annual report of the Canadian Pacific Railway to the Board of Transport Commissioners.

A. Yes, sir.

Q. A copy of which was in my friend's hands and ---

A. Well, I had the reports all certified by public accountants;as to the accuracy of it it was beyond question.

Q. Well, I suggest to you you have left out express and barge service.

A. I suggested that it made absolutely no difference in the substance of this report.

THE CHAIRMAN: Mr. Sinclair, what is the total of the express and barge service?

MR. SINCLAIR: $312,627.

Q. Now, Dr. Ulmer, in computing it there must be rail earnings on equity capital. There are means of apportioning a dividend if in any year rail earnings did not produce any dividends then no dividends would be required under your method?

A. If rail earnings did not produce any dividends other than what ---

Q. No dividends would be required under your method?

A. Oh, no, sir, I disagree with that.

Q. Well, if no dividends were ---

COMMISSIONER ANSCOMB: You mean if no profit was earned no dividend would be paid?

MR. SINCLAIR: No, I am asking him if under his method no dividend was paid.

MR. CUMMING: You said "earned".

MR. SINCLAIR: Q. I am sorry, if no dividend was paid under your method, Dr. Ulmer, no dividend would be required in arriving at permissive earnings?

A. No, sir, I would not agree with that.

Q. If no dividend was paid in one year only, that is why you would not agree; is that right?

A. No, sir.

Q. If no dividend was paid for three or four

years then under your method no dividend would be required?

A. No, sir.

Q. Well, then, why do you say that what may be termed, these were your words, the cost of money is the dividend paid in that year?

A. Are you quoting from something?

Q. Yes.

A. May we have it?

THE CHAIRMAN: Where did he say that?

MR. SINCLAIR: At page 2, I think. I will deal with page 2 where you refer to a dividend of $1.50?

A. Yes, sir.

Q. And you use that as the basis of what you say will be termed the cost of money?

A. Oh, no, sir, that is your interpretation.

Q. But you do not agree with it?

A. I do not agree with your interpretation. I did not say that, I did not say "cost of money".

Q. What should be termed cost of money?

A. No, I did not say that.

MR. FRAWLEY: My friend began by saying "You said such-and-such", and in that case perhaps you had better look at that page and find out what the witness said.

MR. SINCLAIR: Q. All right. There are elements in this total figure and one is the dividend paid. You agree in that figure one of the elements

is the dividend paid?

A. Yes, sir.

Q. Well, would that figure change if no dividend was paid? Would it? That is an easy question.

MR. FRAWLEY: The witness is not used to being shouted at.

THE WITNESS: Yes, that would. May I straighten this out?

MR. MAURO: Let the witness answer.

MR. SINCLAIR: Q. If you want to answer it is your privilege.

A. You have said that this figure of $31,288,000 has been termed by me as the cost of money. I deny this. What I said here ---

MR. MAURO: Mr. Chairman, I say it is about time that a little discipline was shown.

THE CHAIRMAN: Mr. Sinclair, give the witness a chance.

MR. SINCLAIR: I will read the sentence.

MR. FRAWLEY: The witness has not answered. If you do not mind, at least he should be allowed to answer.

MR. SINCLAIR: Q. Will you read the sentence?

A. The grand total, or $31,288,000, may be termed the cost of all the equity capital employed during the year, and this is very different from the cost of money. I shall explain this: this is the money that was paid for the use of capital during this year

and in this sense it may be termed the cost of the capital during this year. Now, this particular cost may be greater than that required over the long run, greater than any reasonable concept of the money to the corporation or it may be less. I go into this later on quite explicitly, I think.

Q. So you say that what is paid in a year does not determine the cost of money?

A. Not necessarily.

Q. Well, it would be happenstance if it did, would it not?

A. Yes, sir.

Q. Now, you apportion dividends on the basis of earnings; correct?

A. Yes, sir.

Q. Now, did Mr. Frawley draw to your attention ---

A. Excuse me, I may have said "Yes, sir" too fast. It was on the basis of retained earnings.

Q. Now, on the basis of earnings, correct?

A. Yes, sir.

Q. Did Mr. Frawley draw to your attention that apportionment of dividends on the basis of earnings from rail plus non-rail had been advanced before the Board of Transport Commissioners and rejected by the Board?

A. I was aware of this from the Board's reports, yes, sir.

MR. FRAWLEY: I am sorry, I must correct my

friend when he says that the obligation of the provinces for the apportionment of dividends was rejected. There has been prescribed by the Board what in the Board's opinion constitutes a proper apportionment of dividends between rail and non-rail. Now, the detail of it I need not go into at the moment.

MR. SINCLAIR: Well, Mr. Frawley, we will see. Dr. Ulmer said he knew it from the reports.

THE WITNESS: If I may amend that, it is my understanding the Board of Transport Commissioners have not apportioned these earnings. I do not know whether they rejected any particular application.

Q. Well, I will refer you to the actual language: page 9, the pamphlet copy of the March 1st, 1950 Judgment of the Board which is reported -- I haven't got the citation, but I read:

"But more important, however, I would completely reject the basis for apportionment of dividends as advanced by respondents."

The basis advanced is explained in the paragraph above, which is a distribution, you will remember, Dr. Ulmer, based on earnings?

A. Yes, sir. I should say I was not presuming here to provide any basis for legal regulation on the part of the Board of Transport Commissioners. I am presenting an economic analysis, hence I still stand by my own method for my own purposes.

Q. Well, Dr. Ulmer, did you know that subsequent to the Judgment that I have just referred to and we have discussed, your present clients, among others, appealed to the Privy Council of Canada from the Judgment of the Board that we have been dealing with, which is known as the 20% Case, and among other matters raised the failure of the Board to determine the apportionment of dividends between rail and non-rail, and the provinces you now represent requested the Privy Council to refer the matter back to the Board to correct its error. Were you told by your counsel in view of your knowledge of the Judgments that the Privy Council held on the appeal that these

provinces had not proved any error on the part of the Board and rejected the appeal under Privy Council Order 5652, November 29th, 1950? Was that brought to your attention?

A. I should say that for my purposes this would not have changed my judgment whatsoever.

Q. That is not responsive, Dr. Ulmer. Was it brought to your attention?

A. I should say these reports were brought to my attention -- not in that specific matter.

Q. You didn't read it yourself and note that the Privy Council of Canada had rejected the basis of apportionment of dividends on earnings?

A. I should say I knew the Board of Transport Commissioners did not make this apportionment. I do not remember whether I read that particular sentence you cited to me.

Q. I am talking about the Privy Council of Canada.

A. Oh, yes.

Q. Was that drawn to your attention?

A. I don't remember whether I read that particular citation, but I knew the effects of it, and that no apportionment was made.

Q. Did you know the provinces had appealed from the Judgment of 1950 that I referred to, to the Privy Council of Canada?

A. I am not sure that I knew it. I probably did not know it. I have a vague recollection of

hearing something about this.

Q. Well, then, your position is that in refusing to follow an apportionment theory for dividends, the Board of Transport Commissioners and the Privy Council of Canada was in error?

A. Oh, no, sir. I am not expressing a judgment about this. Maybe there was an error and maybe not. I do not presume to judge this now. I have had a different objective in mind. I would still do it the way I have done it regardless of the ruling.

MR. FRAWLEY: Mr. Chairman, I said a moment ago that the Board had developed a distinction between the amount of dividend which should be charged to rail as against the amount charged to other income, and I have been looking in the interim to find out that treatment. I am sure it is on the tip of my friend Mr. Sinclair's fingers, and I feel it should be called to the attention of the witness what the Transport Board did, and has continued to do, in the matter of charging up dividends. It runs in my mind that the Board does not charge to rail now all of the dividends which it pays to its shareholders, and that it charges to rail only some of those dividends, and that they regard that -- and I think in the Judgment some such words as that will be found -- they will regard that as the proper disposition that we have made over many years that all of the dividends should not be apportioned to rail. I suggest my friend call that to the attention of the witness, otherwise I will go through the

Judgment and put my finger on that point and call it to the attention of the witness later.

MR. SINCLAIR: Of course, Mr. Chairman, what I am dealing with is a proportion or allocation of dividends on a basis of earnings which is basic to the witness' situation and his method. What my friend is talking about, with all due respect, is a different thing.

Q. I am going to put a hypothesis to you, Dr. Ulmer, and so that you may follow it and have it easily before you I have had it typed out, so that you can read it for a moment. It is a simplified hypothesis, and so that you will not get lost in the language I have had it typed out.

My question is this: "A" inherits a large sum of money and uses it to set up a business. The return on total investment following five years of operation averaged 5 per cent.

"B" sets up a similar business to "A", but raises all the capital by way of loan at an average interest rate of 10 per cent. The return on total investment following five years of operation averaged 5 per cent.

"C" sets himself up in a similar business to "A" and "B". For one-half of the capital he uses his savings and the other half of the capital he borrows at an average rate of 10 per cent. The return on total investment following five years of operation averaged 5 per cent.

In those circumstances, what is the cost of the capital to "A"? What is the cost of the capital to "B"? And, what is the cost of the capital to "C"?

MR. FRAWLEY: Mr. Chairman, I am quite sure the Commission will be willing and my friend as well to allow Dr. Ulmer to study this and see whether or not it is a matter of an application of some algebraic equation -- at least, give him some opportunity.

MR. SINCLAIR: Q. You don't need any opportunity, do you?

A. Yes. I find these examples differ so dramatically from the problem before us -- a great corporation such as the Canadian Pacific -- that I certainly would need time to see just what that difference is.

MR. SINCLAIR: All right, I will defer my questioning for such time as he needs to study it.

MR. FRAWLEY: This requires an interruption in your cross-examination?

MR. SINCLAIR: Of course. It won't take you very long, will it, Dr. Ulmer? I can put these questions, but if you need ten minutes ---

MR. FRAWLEY: Well, don't you tell him what time he needs.

THE CHAIRMAN: There is no use being too aggressive with the witness, Mr. Sinclair, and the witness should be responsive. We will try to get along without unnecessary interruptions. Go ahead, Mr. Sinclair.

MR. SINCLAIR: Well, I am waiting.

MR. FRAWLEY: The witness said he wanted some time.

MR. SINCLAIR: Q. Would you tell the Commission how long, Dr. Ulmer?

A. You had suggested ten minutes and I think thus far you have given me a minute and a half. Would you like to go on with another line of questioning, or let me have a ten-minute period?

THE CHAIRMAN: We are wasting time, gentlemen.

MR. SINCLAIR: Well, if the witness wants ten minutes ---

MR. FRAWLEY: We are not wasting time if the witness says he needs time to answer the question.

THE CHAIRMAN: How long would you need?

THE WITNESS: Oh, ten minutes, sir.

---Short recess.

THE CHAIRMAN: Order, please.

MR. SINCLAIR: Q. Yes, Dr. Ulmer.

A. I had feared on first examining these examples, that sufficient information had not been provided for me in order to answer the question asked as I understand it. I believe the question asked is what is the cost of capital to "A", etc.?

Q. What is the cost of the capital to "A"? what is the cost of the capital to "B" ---

A. You say the capital now, but it does not say so here.

Q. What is the cost of the capital to "A"), to "B" , and to "C") in the examples given?

A. Yes. Well, my notion of cost which I think agrees with the opinion expressed by all major economists at the present time and since the latter part of the Nineteenth Century when these concepts were developed is that the cost of capital to a firm is the minimum amount necessary to keep that capital productively occupied, and this means, of course, in the case of a corporation such as your own, meeting obligations to stockholders, and acquiring the capital necessary to fulfill its obligations to the public, In order to apply that concept, one needs to know something about the alternatives that are available. I do not know that in a case of firm A. I do not know the form in which the money has been invested, the ease with which it could be extracted ---

Q. Let me help you, then. You do not know

the form. It says he inherits a large sum of money.

A. That is the source.

Q. That is the source, and there are no restrictions on its applications; he can invest it as he will. If he decides to put it all into a business ---

A. You have said he used it to set up a business. I do not know in what way this money has been used to set up a business -- whether it has been invested in railroad cars or vegetables or men's shirts, or what. I simply do not know the ease with which he could get this money out of the business, the degree to which it may be sunk in it, or anything else about it, and this is important.

Q. Well, I am going to ask you to assume with me, Dr. Ulmer, that this is a very simple problem that could well be put to you in any university by one of your undergraduates, and he just asks you to help explain finance by taking the most simple of examples. I have told you in example "A" there is no restrictions. You can put it in normal business and the alternatives are the risks that businesses generally have, and that applies to "A", "B" and "C".

A. I would say, sir, that I do not know honestly what a normal business is, and if a student presented these examples to me, I would say they are so excessively simple that we cannot apply the principles we have been learning in this class.

Q. Just allow us to be very simple, Dr. Ulmer. Perhaps you could help us on the simple material before we get into the complex. Would you

try to help us on the simple. You put what qualifications you will on your answer.

A. Sir, these are your examples. I would much prefer you to fill in the details.

Q. I have filled in all the details I think are necessary. If you think additional details are necessary, put them in and so qualify your answer.

Would you please now give the Commission what is the cost of the capital to "A"; what is the cost of the capital to "B"; and what is the cost of the capital to "C"?

A. I am afraid, sir, that I have already answered this question. I cannot provide -- with the information provided for me, I cannot provide an answer to your questions. The information is inadequate, as I see it.

Q. Very well.

A. I have already given you the principle that I do apply to this. We must know something about alternatives available, which are not available in these examples.

Q. The alternatives are the whole alternatives of the Canadian economy. They are the alternatives. The whole alternatives of the Canadian economy.

A. We always have before us alternative opportunities, but the degree to which we are able to take advantage of these may be another matter. But this might differ very severely between A, B and

C. They may not be able to avail themselves to any of the alternatives in the Canadian economy.

Q. I am suggesting to you, make it as a qualification that they have full alternative rights of investment. Under that basis, would you answer?

A. Ah, you are suggesting now that these corporations are each free to extract this money from these enterprises without loss whatsoever?

Q. No, Dr. Ulmer, I am saying that when they put the money in the business they have the full opportunities of alternative investment. The full opportunities.

A. Oh, when they put their money in the business, they had this alternative?

Q. Yes.

A. But the money is in there now, and this is the important thing: what alternatives do they have now. And, really, I must say unless you can help me on this -- I thought you had helped me -- but this would help me on this, and I may be able to answer the question.

Q. All right. I will help by taking example "C". Example "C". The business improves materially in the second five year period so that its return is 10%. Would you like to jot this down; it might help you. So, on his return is 10% on the 50% of equity in the business. He decides to use one-half of that return for capital purposes of the

business rather than borrowing or issuing stock. What is the cost of capital now under example "C"?

A. He earns, you say, 10% on his 50% equity in the business?

Q. That is right.

A. And I lost the second element of this example.

Q. And he decides to leave one-half of that in the business, to apply it back in rather than putting it elsewhere or by issuing securities either debt or equity. Now, what is the cost?

A. You leave me in the same position as I was before. I do not know what alternatives this firm has.

Q. He has the full alternatives of the Canadian economy. He has made money that amounts to 10% on 50% of the investment. He could have bought, if he wished, brewery stock; he could have bought stock in the Toronto-Dominion bank; he could have invested by buying a timber limit; he could have invested in a ship; he could have decided to set up a statistical service to assist labour organizations in presentation before various tribunals.

MR. FRAWLEY: How about Alberta oil? I feel badly.

MR. SINCLAIR: Q. And he could have invested it by buying a ranch. There are a few of the alternatives that are open to him. And he could have, in the last one, bought stock in the Canadian

Pacific Railway.

A. Well, Mr. Sinclair --

Q. These are examples.

A. You have told me in all of these cases; and, once again, in great detail, what this investor could have done.

Q. Yes?

A. But you are not telling me what I have asked; namely, what is it possible for him to do now. And this is the important thing. Once we find this firm in this particular situation, what are its alternatives?

Can it take this money out of the corporation, and take advantage of the grand opportunity of buying Canadian Pacific Railway stock or not? If I knew this, it would help me; but, without knowing it, I cannot answer the question.

THE CHAIRMAN: Gentlemen, we are approaching 11 o'clock. I do not think we have to apologize for working today; it is in accordance with the tradition of those whose memory we hold, and now, I think in honour of their memory we should stand two minutes.

--- Two minutes silence ---

THE CHAIRMAN: I am sure we were all thinking of different people. Mr. Sinclair?

MR. SINCLAIR: Q. Yes, sir.

Dr. Ulmer, is your answer to this Commission

on these questions I put to you that you do not feel you can answer them because you have to have an intimate knowledge of each of the businesses and the environment in which those businesses operate. Is that your position?

A. My position is that I cannot answer the questions stated here without more information than has been provided to me about these firms.

Q. Would you let me put it to you this way, that the type of information you need is an intimate knowledge of the businesses; you need that?

A. I would not say necessarily so, sir, no, but I do need more information than I have here.

Q. What do you need?

A. I do need to know the form in which these investments have been placed. Are they transferable or not, in particular; can the money be taken out without loss or not.

Q. Let me take "C". He had a decision to make as to whether he was going to continue to put money in the business, on the addenda that I put to "C". He had a decision to make. At that time, he had the right to put it anywhere he liked in Canada -- anywhere.

Now, what is the cost of "B" capital to "C" in those circumstances? Never mind about anything more than this one question now for the moment. At that time, what is the cost of the capital to "C" ?

A. Now, just so that we understand one another, we do have "C", an individual, who has

obtained a certain amount of earnings from his business, and he is considering whether or not to do what with the money? What are the alternatives?

Q. The whole of the alternatives available to a Canadian citizen.

A. Well, he is an individual who considers this is money available purely for investment and not for living expense, but for investment. And, now, he is either going to invest it in the Canadian economy or in the firm that he has already established. The remainder of the Canadian economy. Well, in this particular case, for this amount of money, we would have to, presumably, we would have to charge the cost of this capital to him on the basis of the alternatives available.

Q. And that would be the alternatives available, for instance, from bank stocks or anything else in the Canadian economy?

A. Insofar as these are open to him as alternatives, yes. The alternatives actually open to him. Once again, that money has been invested. That is another matter. I am not applying this to the money already invested in the firm.

Q. All right. We will now apply it.

A. But only to this increment.

Q. I would suggest to you that in regard to the increment, the decision he will make as to whether he will put it back into his business or alternative investment that is open to him depends

upon what that existing capital is earning and in prospect. You would agree?

A. With the cost to him, did you say?

Q. That the decision he makes; the decision he makes, Dr. Ulmer?

A. Yes, sir.

Q. The decision he makes will depend on what that equity capital already in the business is earning. Do you agree?

A. Well, no, I would not agree with this. I would agree that his decision would be based on what income he would expect to get from this increment in capital which may have very little to do with the earnings on the total equity already in it, because the earnings on the outside equity in it are affected by many things, not only history, but also the method of finance used in the past.

Q. I suggest to you, Dr. Ulmer, that if the equity he has already in the business is not gauged on ability to earn, the same as any other business, having similar risks and uncertainties, he will not put in the increment and that is the test. You would not agree?

A. I would say that obviously if we have a dollar to invest and it is going to earn 50¢ -- that is, 50% -- this would be a good investment, regardless of what the other dollars may be getting that are already in the business.

Q. Well now, Dr. Ulmer, all right. I see

what you would like to do. You would like to suggest that you have a specific increment that is going to make a large return. Let me put it to you the other way and this, of course, was what I had in mind: that the investment in the business was going to have relatively the same relationship to the investment already there in respect to earnings -- no specific, as you have suggested. Can we go over it again? I suggest to you that in those circumstances the decision of investment in the businees will depend upon the earning on the equity already in the business having relation to risks and uncertaintites similar to that of the business and nothing else.

A. You are assuming, sir, just to clarify this, that he is going to obtain some income from this additional dollar he puts in the business as are the average earnings of equity in the business already. You are assuming that these are one and the same?

Q. Yes.

A. Yes. Well then, of course, in this case he must take into consideration this particular earning he is going to get. It would not matter whether it is equal to the other earnings or not. In this case, you have said it is and, of course, he must consider this.

Q. The only thing he will look at is what alternatives are earning.

A. What alternatives are open to him?

Q. Are earning.

A. What alternatives he has for earning money elsewhere?

Q. Yes. Which, in this case, is the whole Canadian economy.

A. Right.

Q. He can pick and choose.

Now, Dr. Ulmer, in those circumstances, would you make any distinction between the cost of the capital to the industry dependent upon whether it arose from earnings of the industry or money that may come from an outside source?

A. Why, of course, I would make a distinction.

Q. Well, let me suggest to you that instead of "C" putting the money back into the business he decided to take it as a dividend, hold it on his equity, and then he had to go and get equity money outside. What would be the test upon which he would get the money outside from Dr. Borts, we will say?

A. We have Mr. "C" contemplating how to finance a particular increment in investment that he would like to undertake?

Q. He has two alternatives -- either put his own money out of the earnings of the business into his pocket and invest it in all the alternatives that are open to him, and put it in the business, or he takes it out and puts it in alternative investment. He has to go out and attract somebody else's money into his business.

A. Yes, sir.

Q. Now, what is the distinction in the cost of that capital, if any?

A. The distinction in the cost. Now, in the one case we have already said that when he used his own money and is utterly free to take advantage of the earning opportunity in his own firm, and the alternatives. And the alternatives are the cost for this incremental capital.

And presumably getting additional equity capital if he has to get it. This additional equity capital must overcome the same cost barrier.

Q. They would be identical?

A. Yes.

Q. Now, Dr. Ulmer, in the situation that you have just explained the capital which is represented by retained earnings and the capital that is represented by external sources is the same. Now, then ---

A. No, I did not say that. What we were talking about was an increment.

Q. I am sticking with the increment in regard to the money, that is, increment whether it is retained or secured from outside sources the cost of capital is the same.

A. In the case we have envisaged here.

Q. And the decision making as to whether retained earnings will be met is dependent upon the earnings of capital held in the business. We agreed on that.

A. Yes, sir.

Q. So we have got that all equated. I say to you, and my question is now, why do you in your proposals treat retained earning capital different than capital raised by the actual issue of securities.

A. I am thoroughly consistent in principle here. Again, you are referring -- that is why I insisted on the word increment here because the particular example we had in mind is very different

from the CPR. I have defined a cost as a minimum amount necessary to keep capital in the firm occupied productively in the firm plus the amount required in order to enable this firm to acquire, in the case of the CPR, the amounts necessary to fulfill its obligations to the Canadian economy. In this case, to retain earnings in the Canadian Pacific is in a very different situation from one in increment in retained earnings the CPR may get and the disposition made of it. Even more so is the difference between the situation of the Canadian Pacific Railway and that of Mr. "C" in your example who was an individual, not under public regulation.

Q. Well, Dr. Ulmer, are not retained earnings merely successive increments? Surely you are not going to suggest that there is a distinction between successive increments and the whole, are you?

A. Oh yes, I am.

Q. You are?

A. Yes.

Q. With regard to decision making?

A. Yes, sir.

Q. Are you suggesting that if the capital held in the business is not treated the same as alternative sources that management that accounts for Canadian Pacific are going to put it back into the business if they are going to be denied the right to earn similar amounts as alternatives?

A. My suggestion is that the rail earnings

that have been built up historically over time, that the alternatives available on these rail earnings must necessarily be considered if they cannot be removed by some magical wave of a wand from a firm in place of alternatives. These alternatives are not -- it is a relationship that is considered by the market. I know of no great corporation in the United States or Canada which shows on its accumulated surplus the same market rate of return that you apparently would like to have applied to it.

Q. Well, you do not know of any Canadian business that earns the same amount on the shareholders equity business as it does in respect of the money that it is receiving, is that what you said?

A. Yes, that is what I said with a qualification, where the surplus is a substantial amount as it is in the case of the CPR.

Q. Let us take a year in which a company which is a large company, it has $100 million dollars available and it can either pay it in dividends, it can pay part of it in dividends or it can pay none of it in dividends. What would the cost of capital be under those alternatives?

A. What would the?

Q. Cost of equity capital be to that company for $100 million dollars under those alternatives.

A. This concern is utterly free not to pay a single dollar in dividends but can plow it all

back.

Q. Or pay it all out or do it 50-50. What is the cost of that $100 million dollars capital (A) when it pays out all of it; (B) when it keeps it all and pays nothing out and (C) when it pays out half and keeps half and, of course, keeps over 50%. The key is $100 million dollars.

A. Yes. I find it very difficult to answer this question because it again seems so unreal. I know of no corporation that is utterly free not to pay a single dollar of dividends. With these huge earnings there are obligations to stockholders.

Q. Let me give you the example: we have a very large corporation that can either pay off debt, retired debts security and not pay any dividends and it does so. Under your proposal would that affect the cost of capital?

A. It now has the alternative of paying off debt.

Q. Yes.

A. Would that affect the cost of capital?

Q. Yes.

A. I would say it is different but in the alternative, actually before a firm enters into the whole picture of what the cost of capital is today, yes, sir.

Q. What would the cost of capital be if alternatives were these: They could pay the money out to the shareholders who could invest it at an average

rate of return of 15% or they could take that $100 million dollars and retire debt in an existing company. Now, if the $100 million dollars has been put into the business, what is the cost of the capital?

A. I cannot answer this. The need for plowing money back into any concern is a rather complicated thing. Sometimes the whole destiny of the firm depends upon this and a particular figure as in an element of cost is rather difficult to assign, so is the obligation to pay dividends at a reasonable amount. This is something, in general, that is determined by past behaviour, history as well as market judgment. I think, without some knowledge concerning these things, it is difficult to generalize. I have tried to point out that this concept of the cost of capital must be applied to a particular firm knowing what its circumstances are.

Q. That is what I put to you before. Before you can answer questions on financial matters you have to have an intimate knowledge of the financial structure, the problems of the particular firm and its necessities and demands upon it.

A. I would hesitate again because you are suggesting intimate knowledge which perhaps only you and some other financial officers of the company may have.

Q. I am not a financial officer of the corporation.

A. Excuse me, you and financial officers of

the corporation have. I think it is necessary to have before one the relevant information to any problem and if I had relevant information in any of these problems I could answer the question.

Q. You have to have a great deal of knowledge about the particular business?

A. No, but have the relevant information.

Q. Which is a great deal of knowledge in finance, a great deal of knowledge. You will agree with that?

A. I am not sure what you mean by "a great deal of knowledge"?

Q. Well, for instance, let us take one particular item, the debt equity ratio of a corporation.

A. Yes, sir.

Q. You have to have a great deal of knowledge of the company and the environment in which it works before you can determine a proper debt equity ratio for a corporation. Correct?

A. Yes, sir.

Q. So that, for instance, in the Canadian Pacific you are not going to suggest that its debt equity ratio is not a proper ratio, are you?

A. I do not enter into this problem in my report.

Q. Well, I am going to show you possibly that you did necessarily so but you are not going to suggest in any event that the debt equity ratio of Canadian Pacific is one that you are challenging, are

you?

A. I have not explicitely challenged it in my report.

Q. And you are not prepared to do so now, are you?

A. Well, I would say I do have certain reservations about the debt ratio, yes sir.

Q. You think it should be lower or higher?

A. I think that the answer to this question depends upon the particular financing situation to which we may make reference. Now, I would say that if interest rates had declined substantially in the future which, at least, is a possibility, that it might very much be to the advantage of the Canadian Pacific if it must make resort to outside capital to increase its debt ratio.

Q. You say you have some reservations about it and we may not be in the same ball park. What is the debt equity ratio of Canadian Pacific, approximately? I do not want to have it to the third decimal.

A. It is about 35%.

Q. Are you taking corporate or rail?

A. This is a corporation figure, I believe.

Q. And what suggestion do you make that would put the maximum debt -- we will accept your figure because it is close enough, I think it is about 33?

A. What was the question?

Q. What is the maximum that you would think

for the rail enterprise of Canadian Pacific would be a reasonable debt ratio?

A. I would not care to undertake an answer to that.

Now. The reason for my reference here is that the debt ratio in the Canadian Pacific Railway is below that of the average of other great railroads.

Q. You mean like the Pennsylvania?

A. I mean like the average of the major railroads in the United States for which the figure is above 40%.

Q. Do you mean in the United States?

A. Yes.

Q. Do you think the debt ratios of the railways in the United States are a matter of business judgment or business assessing?

A. All decisions are a matter of the circumstances in which they are made as well as the reasonable judgment we are making.

Q. I suggest to you that the railways in the United States in the average that you talk about can get no money other than debt money and that is why the debt ratio is where it is today. Will you agree with that?

A. It is certainly one of the circumstances that affects their decision. I should say making reference to this matter was not based merely on this revenue percent but based rather on the nature of the Canadian Pacific Railway, the nature of its income and

its intimate connection with the Canadian economy. Any great corporations of this kind, a really substantial debt of ratio ordinarily can be easily tolerated and it is a saving to the economy which is what I had in mind.

Q. Dr. Ulmer, the reason why -- you approach the Canadian Pacific in your answers on the public utility concept, correct?

A. Yes, sir.

Q. Of debt ratio?

A. Yes, sir.

Q. And the basis that will enable the public utility to have a high debt ratio is correlated with its monopoly position, I suggest to you.

A. I would say it is correlated with the relatively stable nature of its business.

Q. I suggest to you it is correlated and is dependant upon the security that has come from the regulation of a monopoly enterprise.

A. Well, as long as you bring in the term "security" I would go along with this because stability is the key factor here. It is easily possible to conceive of a monopoly, the financing of which may be quite volatile. That is why I hesitated.

Q. You are not suggesting that the Canadian Pacific is in a monopoly position, are you?

A. No sir, I did not suggest this, I did not make reference to this at all.

Q. Well, I am asking you a question: in

your view is Canadian Pacific in a monopoly position?

A. I would say the CPR and every railway that I know about is subject to certain competition in many branches of its business, maybe not all branches of its business.

Q. What proportion of the CP business do you think is in a monopoly position, just keeping to Canadian Pacific?

A. I just cannot comment on this, I do not know.

Q. I suggest to you that it is infinitesimal would you agree with that?

A. I said I do not know.

Q. You would not like to make a judgment analysis of it?

A. No, sir.

Q. Do you not think it is necessary to be able to make a judgment analysis of the situation before you determine what would be a reasonable level of earnings?

A. No, sir.

Q. I presume, Dr. Ulmer, that you will agree that in approaching equity cost, the cost of equity capital, this is dependant, the cost that you are to assign to it is dependant upon the degree of monopoly that the industry has. I am talking about a regulated industry?

A. The cost of equity capital is dependant upon the degree of monopoly?

Q. Yes.

A. I certainly have not said this.

Q. I am asking you do you not think in approaching the fixing of costs of capital on equity in a regulated utility that this cost is in part dependent upon the degree of which it is in the monopoly position. You do not agree with that.

A. No, I do not.

Q. Will you agree with this -- before I do that -- as I understand your approach, you believe that depreciation accruals should over the life of the asset meet the replacement cost of the asset?

A. I think this, in the light of the accounting techniques, this is an impossibility.

Q. But then you believe that depreciation accruals should be on original costs, should be augmented by ear marked funds to make up the difference in the replacement in kind of the original cost and current cost in the life of the asset?

A. I think I am in agreement with this. Depreciation charges ought to be augmented by a certain amount of retained earnings in order to make possible replacement of capital equipment as it is used up in a period of inflation which, of course, we are referring to.

Q. You are not expecting to change, are you, particularly in your country?

MR. FRAWLEY: Anything may happen now with the new president.

THE WITNESS: I do not have my crystal ball

right here and perhaps I can answer that on another occasion.

MR. SINCLAIR: Q. In view of what president-elect Kennedy has said, and I am sure you believe he will carry out his intentions, you do not expect inflation to stop in your country, do you? I am asking you as a financial man?

A. I really have not come prepared to answer this question. Obviously, I do have certain opinions on it but it is not an easily handled question.

THE CHAIRMAN: It is too early to ask these questions.

THE WITNESS: We must remember that president elect Kennedy ---

MR. FRAWLEY: No, don't both with that.

MR. SINCLAIR: Q. Another concept that arises is this, that in depreciation accruals you believe in the production method so as to reflect in the accruals heavy work in a given period.

A. Is this right?

Q. The concept that you have is that depreciation should be on the production method, so that in a given period of heavy use the depreciation accrual would be maximized or augmented over the straight line basis?

A. I did not express any comments on this, sir.

Q. I am asking you.

A. Oh, would I agree with that? I should say that I, again, may not be prepared to comment on particular accounting techniques which I believe is what you are inquiring about now?

Q. I am asking you about concepts, Dr. Ulmer. I am asking you about your personal concept as a financial man, as a financial teacher -- what your position is in regard to this matter. And I will rephrase it.

You believe in the concept that depreciation accruals should be on the production method so as to augment accruals at times of heavy use. Correct?

A. I, again -- I do not think I can answer this. I would like to do my best for you if you will permit me to. I would say that I would not personally undertake any campaign to revolutionize the accounting business. But I do think that obviously prudent management when it knows that it is using its equipment at a faster than normal rate would be making some extra provision for its replacement. Now, whether this was strictly a depreciation accrual or some other

[illegible]

form is another matter.

Q. What your answer means is if the production method is not used well in those periods you would have a higher retained earnings necessary. Is that a way of expressing it?

A. Yes, sir.

Q. In approaching Canadian Pacific permissive level of earnings, did you know how the depreciation accruals are made on Canadian Pacific?

A. No, I do not know the precise method used in compiling these.

Q. How did you evaluate the amount of retained earnings necessary if you did not know the basis upon which depreciation accruals -- whether production method, or straight line, or whether they had assets that were having to be replaced in kind at a higher cost?

A. I have examined the records of your corporation bearing upon its investment practices in the past. Now, what particular accounting technique we used in compiling the depreciation charges, I actually did not concern myself with. As I have already suggested, I did not think this was so important. I think the important thing is that funds be provided for replacing capital that needs replacement. If the actual accounting depreciation charges are too low or too high is another matter.

Q. But in regard to Canadian Pacific you did not make any appraisal of this in arriving at your

permissive level of earnings?

A. Appraisal of what? Of the depreciation techniques?

Q. Yes, and their source?

A. I certainly looked at those figures. Now, how you would arrive at your depreciation charges, no, sir, I did not go into this.

Q. If it was on a straight line basis, rather than a production basis, and if its depreciation accrual only recovered original cost over the life of the asset less salvage, these two factors -- these two hypotheses would require a higher retained earnings?

A. Oh, yes, sir.

Q. Now, Dr. Ulmer, I want to ask you if you would agree that the principles of regulation of a company are, first, maintenance of the public interest; and, second, the assurance that the wells of risk investment shall not be dried up?

A. That last phrase, sir, is something that makes me hesitate. I am not sure what it means.

Q. You are not sure what it means. I suggest to you that what I have done -- it is a quotation:

"The principles of regulation are first maintenance of public interest, and second the assurance that the wells of risk investment shall not be dried up".

MR. FRAWLEY: My friend is quoting from something and I think he might let the witness know what he is quoting.

MR. SINCLAIR: Q. Do you happen to know J. G. Diefenbaker?

A. Yes, sir.

Q. What does he do?

A. Prime Minister.

Q. Well, those are his words. Now, what do you think of it now?

MR. FRAWLEY: Don't answer that.

MR. SINCLAIR: Q. I am serious, Dr. Ulmer. I want your answer as to whether you would agree that the principles of regulation are, first, maintenance of the public interest, and, second, the assurance that the wells of risk investment shall not be dried up?

MR. FRAWLEY: If my friend is serious, then I am equally serious, and I think the witness should have the context in which that was said; what kind of regulation the Prime Minister was speaking about, and generally the setting of those words that he is asking the witness for his comments upon. Would you give him the full text of the speech?

MR. SINCLAIR: Let the witness put what qualifications he feels should be put on the words.

MR. FRAWLEY: With great respect, that does not dispose of my objection. My friend is certainly aware of the rules: when you are cross-examining a witness on a text, you must show that text to the witness. Let us get the text and see the connection.

MR. SINCLAIR: I have this quotation, and I

am asking the witness if he agrees with it, or what his comment on it is. I will let you comment on it, Dr. Ulmer.

MR. FRAWLEY: My friend is just brushing aside my objection, and I object to that. It is no different than if he was quoting Aristotle. Let us know under what circumstances these words were said.

THE CHAIRMAN: I think Dr. Ulmer has probably problems enough in his own country without passing the Nile.

MR. FRAWLEY: The Prime Minister has said many, many things over a period of many years -- when he was leader of the opposition, and when he was Prime Minister. I think the witness should have some knowledge of the setting of these words.

MR. SINCLAIR: Q. In economic thought, it should not make any difference as to whether you are one side or the other; should it, Dr. Ulmer?

A. One side or another?

Q. In regard to any problem?

A. That is correct.

Q. And you would not expect the Prime Minister to have different views depending upon whether he was upon one side of the House or the other; would you?

A. Of course I would.

Q. Why?

A. Because the reason he was elected Prime Minister is because he stands for certain principles in

which the majority of the people believed.

Q. And he changes them after he gets elected?

A. Of course not, no, but he stands for them.

Q. And it is the same whether he is on one side or the other?

A. Oh, you mean when the individual walks to one side?

THE CHAIRMAN: We will pass on from that.

MR. SINCLAIR: Q. All right, Dr. Ulmer. My friends do not seem to want to have your theories decided by another authority, but I will go on to another question.

THE CHAIRMAN: Nor does the Commission.

MR. SINCLAIR: Q. I will go on to another matter. You would agree on regulation that a regulated industry must not be prevented by regulatory action from earning a return sufficient to attract capital nor must management be deprived of the normal incentive to improve efficiency?

A. Now, you see, this word "attract" -- this phrase "attract capital" is one that I attempted in my paper to analyse, and you know that I do not accept it at its face value; that it must be examined quite critically, and in specific reference to the firm under study.

That certainly -- if this means that the firm must be in a position at all times to attract large amounts of outside capital, I would say this is distinctly

not so.

Q. As a principle, we would agree, I would think, Dr. Ulmer, that regulation must not prevent by any action of the regulatory a return sufficient to attract capital nor must management be deprived of normal incentives to improve efficiencies. Those are two musts?

A. I certainly agree that management must not be deprived of normal incentives to improve efficiency. I think this is extremely important, and if you would change the word "attract" to "acquire" the capital necessary for its operations in the public interest, I would agree with that fully. "Acquire capital".

Q. I will put it to you once again, Dr. Ulmer. Regulated industry must not be prevented by regulatory action from earning a return sufficient to attract capital, nor must management be deprived of the normal incentive to improve efficiency. My question is, do you agree?

A. Well, you see, you are asking me, I presume, to give you a yes or no to a question of this kind. The important phrase is "attract capital". It has been interpreted in testimony different ways, and I hesitate to say yes or no to that. If you would change the word "attract" to "acquire" the capital necessary for its operation, I would agree with it. I think I have made my position utterly clear, without reference to whether I say yes or no to that question.

Q. Well, now, Dr. Ulmer, I should tell you,

and I want to be fair to you, completely so, that the question I have put to you and to which you have answered is a quotation in part -- a key part of it is a quotation from a statement made by the Honourable Minister of Trade and Commerce of Canada.

A. Oh, I realize, and this is a frequently used quotation, sir, and what I am saying is that it has been interpreted in such vastly different ways that we must be careful when giving assent to it.

Q. So that you must, in the business and the environment in which it is operating, before you can apply principles such as I have enunciated, and which you feel in changing the word "attract" to "acquire" you could agree with ---

A. You must have the relevant information, as I earlier stated.

Q. Now, in determining what is the reasonable permissive level of earnings on a regulated utility, Dr. Ulmer, you will agree special or unusual circumstances must be taken into account and reflected?

A. Yes, sir.

Q. If a utility had a special circumstance where, for the national interest, it was required to perform a large amount of service at unremunerative rates, that was a circumstance that would have to be given weight to in the permissive level of earnings that you would fix; is it not?

A. Yes, sir.

Q. And if an industry had been operated

pursuant to legislative fiat and had been providing a large amount of service at unremunerative rates, that would adversely affect its earnings?

A. I think quite obviously, sir, if the rates were unremunerative.

Q. And so, therefore, when you use "earnings" as a basis of permissive level or cost, you have to, first, determine whether there is or has been over the period that you are using any deleterious ramifications arising from legislation in the country applicable to the industry or applicable to the economy?

A. Not necessarily, sir.

Q. Not necessarily. Well, when would that not be so?

A. Well, now, whether some rates were too low or too high is certainly a matter that any Board or group must consider when studying the structure of rates, but when studying the overall adequacy or inadequacy of outside earnings, this is another matter. The financial considerations are important here, not whether a particular rate is too high or too low. It might be balancing out at various rates in the rate structure.

Q. I put it to you, Dr. Ulmer, that if you were going to look at earnings as a measure of determining a permissive level, then you have to take into account and make allowance for factors such as special circumstances relating to depressed earnings or national policy considerations which could adversely

affect the earnings that you were using as the base for your determinations. You would agree with that, would you not; surely?

A. Well, I have always said that in considering a level of -- a permissive level, whether some rates are too high or too low may not be relevant.

Q. But if you use as a condition of the determination of the permissive level the actual earnings in the method that you are following the proposition I put to you that you had to give weight to the special circumstances would certainly apply; would it not?

A. I am not sure what you mean by saying taking actual earnings as a standard. I certainly would not, nor do I know of anyone who would purely take actual earnings as a standard for determining permissive earnings. Not simply this.

Q. But, insofar as if it was not simply that but was a factor in the determination, a major factor, then you would have to make allowances?

A. [illegible] think this is necessarily so.

Q. I suggest to you that in your method of determination of permissive earnings you, Dr. Ulmer, have assumed that $1.50 dividend of Canadian Pacific, first, is reasonable, and secondly will be continued in the foreseeable future without any objective basis upon which to make either of those assumptions. Would you agree with that?

A. [illegible]

Q. Well then ---

A. You said "without any objective basis", I certainly had an objective basis.

Q. What is it?

A. Well, for one thing the dividend for $1.50 has been paid quite steadily in the past.

Q. Are you now talking about your test of [illegible]ness, the test of the reasonableness of [illegible]

A. Yes, sir.

Q. All right, the fact that it has been paid in the past?

A. Yes sir, the fact it has been paid in the past is certainly a relevant fact here.

Q. And this is the basis, its being reasonable?

A. Not entirely.

Q. It is a major factor?

A. It is one of the factors.

Q. A major one?

A. I am not sure. May I tell you the rest of the factors?

Q. All right.

A. Well, I examined also the price prevailing for this security.

Q. Market price?

A. The market price of the common stock. The yield ---

Q. The yield on what?

A. On this common stock, that is the relationship between the dividend paid and the price, the yield in previous years.

Q. That is yield on market?

A. Yes, sir, the yield in previous years for the security.

Q. Again on market?

A. Yes, on the common stock, the market price of the common stock. I have examined this yield historically, the price of the security historically and the relationship to its yield and other yields available of a roughly similar character.

Q. Those are the elements you took in: one was the payment of the dividends?

A. Yes.

Q. The dividends paid in the past, that is one of them and this is the one you put first. Now,

let me look at this. If that dividend over the past had been $2.00 instead of $1.50 under your basis I suggest to you automatically the permissive level of earnings of the cost of money, as you determined it, would increase?

A. I would say we are all, to some extent, prisoners of the past and if for some reason regulation of your company and your company's state would be such that a $2.00 dividend would be paid for the last twenty years, there would be an obligation to continue this payment or at least approximate it because the market would be attuned to this situation.

Q. If no dividend had been paid for say ten years would this have been, in your view, determined as No. 1 on your hit parade, a reasonable level of earnings.

A. Well, as I say, we are all to some extent conditioned by the past. If for some reason your corporation had been in a position of not being able to pay dividends for some long period of time, surely this would be considered by everyone a very unfortunate situation and one would not expect this fortunate situation to continue indefinitely. I should say also that once it did become possible to pay a dividend on this security why this would be, unless it had been quite definitely foreseen in the past, a pleasant surprise for those in the market and for the stockholders too.

Q. Do you know whether the Canadian Pacific

ever passed dividends?

A. I am not absolutely certain whether it did or not -- I do not remember.

Q. If it had passed them for a number of years this would have a reflection now in the security and the attractiveness of the stock.

A. It depends on how far in the past it was. Now, in the 1930's this was such a common occurrence even in the financial markets ---

MR. FRAWLEY: Perhaps you would like to see this.

MR. SINCLAIR: I wonder why my friend is handing material to the witness. Is this something I raised?

MR. FRAWLEY: You raised passing dividends.

MR. SINCLAIR: You could wait until I have asked a question. Now, there were substantial periods of time extending into the 1940's -- here is Canadian Pacific passing dividends in the 1940's, do you think that has a depressing effect on the value of this stock on the market today?

A. This was not the only railroad in the western hemisphere which was in this situation.

Q. I am talking about Canadian Pacific. You did not know but my friend has handed you the sheets and now you know that they had passed the dividends for quite a period in the 1940's?

A. Yes.

Q. Now, do you think this has a depressing

effect on the value of Canadian Pacific stock on the market today?

A. I have said that what had to be considered here was the reasonable expectation of investors and those who hold the securities, especially the stockholders. Now, if this experience of the 1930's and the period immediately after the 1930's affected their expectations it would have to be considered. But, this was the greated depression in the history and the railroads came out in an unusually weakened condition. We all know this and most of us consider this is not a possibility for the future at all.

Q. It is not a possibility for the future at all?

A. Yes, sir.

Q. Did you ever hear that a careful economist should not be a soothsayer?

A. You are making reference to the fact that I wrote an article with this title.

Q. Most people find it difficult enough to be historic without being a prophet.

A. I should say I voice not a personal prediction in making this statement but what I think has been considered to be so, that the Democratic nations of the world are rather determined not to permit a catostrophic depression of this kind ever to occur again.

Q. I want to take you right to the suggestion that because of the depression and the

depressing effect of the great depression on railway earnings the railway industry was adversely affected in the 1930's. This country became part of the war effort of the British Commonwealth in 1939. If you look at what Mr. Frawley gave you, notwithstanding war traffic on the Canadian Pacific Railway, starting in 1939 and 1940, would you like to read off how many years after 1940 it was before dividends were paid on the common?

A. How many years after 1940?

Q. Yes.

A. It looks like two years here.

Q. Yes, 1941 and 1942 and did you notice that in part of that period even a dividend on the preferred was not paid?

A. Yes, I see this.

Q. Now, if the reasons for the dividends being not paid or depressed in part of those years and part of the retained earnings were taken to pay off debt securities, the shareholders would have a right to expect that as a result of that action their dividend in the future would be greater. Would you agree?

A. If the fixed applications were reduced here?

Q. Yes.

A. Yes, sir.

Q. Have you studied the CPR study to see whether there was a plan and policy of reducing fixed charges to enable higher dividends to be paid?

A. My recollection is that some fixed obligations were paid off by your railroad as its conditions improved and this became possible.

Q. And did you give weight to that anticipatory action to the shareholder in fixing your permissive level of rates?

A. Anticipatory?

Q. The anticipatory view of the shareholders by relinguishing earnings on this stock at one period to pay off debt there were going to be more available at a later period?

A. I do not think the stockholders of the CPR or any other stockholders are anticipating a repetition of this depression of the 1930's.

Q. Now, with all due respect that is completely unresponsive and you know it. I asked you a completely different question to that.

A. Well, I am sorry. I misunderstood you.

Q. I will put it to you again. I am asking you as to whether you gave any weight to an anticipatory action being in the minds of the shareholders following a policy of CPR of paying off debt so as to secure higher dividends?

MR. FRAWLEY: How the witness can speak of what was in the minds of the Canadian Pacific shareholders is completely beyond me. I do not think he should have to answer such a question.

THE WITNESS: I can only judge ---

MR. SINCLAIR: Of course, before he answers

I must say to my learned friend that this man has used the words "the expectation of the stockholder" himself so I am quite properly testing his knowledge of Canadian Pacific in the expectation upon which ---

THE CHAIRMAN: He was answering your question.

THE WITNESS: I can only judge the reasonable expectations of stockholders on the basis of market behaviour, objective market behaviour and this I would do for the holders of Canadian Pacific or any other security. As I have indicated, this is a matter of history as well as current behaviour of the price.

Q. Do you think any weight should be given to book value in your assessment per share?

A. In my assessment per share, I have not made any assessment per share.

Q. I am asking you in fixing the level of permissive earnings do you think that any weight should be given to book value per share?

A. I do not think this is an extremely relevant item to be considered in fixing permissive earnings.

Q. In fixing permissive earnings you think you should pay no attention to book value per share?

A. I would not say no attention. May I show how this enters the picture? I think that book value per share is one of the factors that affects the safety of a security. Now, the safety of the security of the Canadian Pacific Railway is considered quite high. It is interesting that I asked the biggest

brokerage firm in the United States about this security before coming here just wondering what kind of information they had on tap. Safety is the great factor emphasized and apparently in the stock market, according to Mervill Lynch, Pierce, Fenner and Smith they consider it is a security which an investor can buy on the basis of expectations of steady income. To go back to your original question, I think that book value per share is a problem in this connection but assuming that we do have a security the value of which is not -- the basic of which is not in danger, I do not consider it is an important factor in determining permissive earnings.

Q. What did you mean by the basic value of the security not being in danger?

A. I mean simply that the probability of your firm to pay a dividend of $1.50 in the future is very high over the long run.

Q. I am sure you know what is the book value per share of Canadian Pacific?

A. I do not recall.

Q. Well, roughly, having in mind -- you know its market price, what is its market price?

A. It is very high.

Q. What is it market price.

A. It is about $22.00.

Q. $22.00?

A. Yes, sir.

Q. When did you look at it last?

A. Oh, it was fluctuating down between $21.00 and $22.00 over the last several ---

Q. And what would you think in relation to this book value that the market price would be, about the same as the book value?

A. Oh no, I would say the book value is quite a bit higher than this.

Q. How much?

A. I have already said I do not know and I would rather not say.

Q. But in the judgment ---

THE CHAIRMAN: He has said he does not know.

MR. SINCLAIR: Q. I would like the witness to answer the question because he admitted to me he has to take a look at this in dealing with permissive earnings.

A. Only if the book value is extremely low and I know it is quite high in this case and it is not a relevant factor therefore.

Q. Do you think if the market value of the share was equal to the book value or was very close to it that that would require a higher permissive level of earnings?

A. I cannot answer just in a general sense.

Q. The Canadian Pacific?

A. The big question is, would one consider that the earnings on these shares, the earnings available for dividend payments on these shares, are they in danger. This is the important factor. If that

possibility was affected by the book value on shares well one would have to ---

Q. If the book value per share of Canadian Pacific was close to the market value would this, in your opinion, result in a necessity for a higher level of permissive earnings?

A. I would say that if that is the fact ---

THE CHAIRMAN: Will you be much longer?

MR. SINCLAIR: Oh yes. This was rather a crucial question and the witness was in the middle of the answer but if you want me to stop now ---

THE WITNESS: I was about to say that if the book value of the stock affected the safety of the security dividends then I would consider it.

MR. SINCLAIR: Q. This is not the question I put to you.

A. It is the only way I can answer the question you put to me.

Q. The question I put to you was, if the book value per share of Canadian Pacific was close to the market value under your approach would this require a higher permissive level of earnings.

A. My answer is, not necessarily.

Q. In the specific case of the Canadian Pacific, would it at the present time?

A. I find it difficult to change the picture of the Canadian Pacific so radically as you are asking me to do.

Q. Have you applied theoretical concepts to

the application of level of permissive earnings that you arrived at?

A. Yes, sir.

THE CHAIRMAN: We will adjourn until 2 o'clock.

--- Luncheon adjournment ---

THE CHAIRMAN: Order, please.

MR. SINCLAIR: Q. Dr. Ulmer, you agree there is just as real an obligation by a company to its stockholders as there is by a company to its debt security holders?

A. Well, no. In the one case there is a legal obligation and in the other case there is none.

Q. I said just as real an obligation. The obligation -- one may be contractual and the other non-contractual, but the obligation by the company is just as real.

A. I do not think so, sir. In the one case the legal obligation is a substantive insurance against risk and in the other case this is absent.

Q. But when a person is going to invest in a company, he makes a decision as to whether he wants to adopt security or to take risk. If he wants security, he buys debt securities and if he wants to take greater risk and the possibility of greater profit he takes equity?

A. Yes, sir.

Q. And, in making that assessment, he of course expects that in taking equities he is going to be given the opportunity for a greater return for the greater risk?

A. Yes, sir.

Q. And he expects the corporation to acknowledge to him a real obligation to make payments to him commensurate with the risk that he is taking?

A. Yes, sir.

Q. Now, Dr. Ulmer, in the determination by Canadian Pacific of the cost of money which was covered in the memorandum regarding cost of capital, it was clear that the cost of debt capital was on an historical basis?

A. Yes, sir.

Q. You agree with that method?

A. Of course, I do agree with that method. I would hesitate to accept every figure that I found in this document. I attempted to trace them back and was not able to do so.

However, the differences are not very significant in the aggregate. This was my only qualification.

Q. Now, when you come to determine a permissive level of earnings ---

A. Yes, sir.

Q. --- you must look to the future; correct?

A. Yes, sir.

Q. And that is why in your paper you, in looking at permissive earnings, looked into the future and, with respect to the interplays of the money market you made an appraisal and an analysis and a prophecy, shall we say?

A. I did not look into the future of money rates, sir. I took them pretty much as they are at the present time.

Q. Well, on page 4 of your paper that is now before the Commission, you suggested that some

authorities -- I am quoting ---

"Some authorities have expressed the judgment that their peak has been definitely passed and the downward trend will continue."

That is having to do with interest rates?

A. Yes, sir.

Q. Were you one of those authorities?

A. No, sir.

Q. Well, do you agree with that assessment?

A. I think there is some probability that would be attached to that, yes, sir.

Q. Dr. Ulmer, in your appraisal of permissive level for Canadian Pacific, did you and in light of this possibility of the peak of interest rates having been passed and the downward trend evident, and which you have now indicated the probability of that would continue ---

A. I did not indicate the probability -- I said that some authorities thought so, sir. I did not express my own judgment on this.

You have asked me in here at the moment whether I think so. I think there is some probability, but I did not say how high it is. I am not at all certain that this is so. It is quite possible that interest rates may level off at their current rate for a while.

Q. For instance, Dr. Ulmer, did you check the probability or the sum probability that they had passed their peak and were continuing their downward trend by checking, for instance, long-term Canadian

governments when you made your submission, and at the present time?

A. I have looked at interest rates generally as indicated in the table. I did not include a long-term rate for Canadian governments, but the short-term rate of Canada and bonds generally in the United States -- a selection of bonds in the United States.

Q. I am talking about Canadian.

A. Yes, sir.

Q. Have you looked at the Canadian market situation -- the money market situation -- since you wrote this paper which was, I take it, around the end of September; correct?

A. Yes, sir.

Q. And the present time?

A. Yes, sir.

Q. You have?

A. Yes, to some extent I have. I have looked at it, yes.

Q. Well, then, you would have noticed, then, for instance, that $4\frac{1}{2}$'s, Canada's 1983, on September 28, were yielding 4.89 at a price of 94 11/16ths. On November 10, 1960, they were bid at 90 -- a drop in price of more than $4\frac{1}{2}$ points, which, of course, necessarily increases the yield. Three-quarters on 76 on September 28, 1960, were yielding 4.69 at a price of 84 1/8th. On November 10, 1960 they were bid at $80\frac{1}{4}$; a drop in price of a little under 4 points. Again, in this six weeks, a substantial increase in

yield. Five and a halfs of Canada of 75 on September 28, 1960, were yielding 5.06 per cent at a price of 104 9/16ths. On November 10th they were bid at 102, a drop in price of a little under 3 points. Again, showing an increase in yield?

A. Yes, the same increase in yields -- a slight increase in yields -- as occurred in the United States over this period. And, yet, I read in your own Financial Post here, again, the opinion that interest rates are going to turn down subsequently.

Now, I have not personally expressed an opinion on this. In this matter, I took the current rate pretty much as it is.

Q. But you did, in fixing permissive level, look into the future, as you said in your answers to me.

A. Look into the future?

Q. Yes.

A. Not particularly on interest rates. I did not make any assumption of substantive change in interest rates in the future in connection with these earnings.

Q. For instance, Dr. Ulmer, I suggest to you -- have you looked at the Bank of Canada statistical summaries?

A. Yes, sir.

Q. And I suggest to you that any analysis in the Bank of Canada statistical summaries will indicate quite definitely that this downward trend in interest rates stopped in August last in this country,

and that there has been an upward trend which, up to the present moment, shows no sign of slackening. Would that be a fair summary of it?

A. Well, I have seen opinions to the contrary. I have one in my pocket which I just tore out of the paper yesterday because I thought it was interesting.

Q. Now, Dr. Ulmer, on page 5 of your paper you were bold enough to suggest that Canadian Pacific could finance at 4½ per cent?

A. Equipment trust.

Q. Equipments, yes. Can you say there is a market for equipments, railway equipments, in finance or there has been one in recent times in Canada?

A. I did consider it possible that taking the next two years composite that this is a rate which very likely would prevail.

Q. Well, did you know that, for instance, the Canadian National Railways raised very large capital sums in the last few months?

A. Yes, I do know this.

Q. Do you know what they paid for them?

A. Yes, it was just about very nearly -- they did this financing in about the peak of the interest rates; very close to it -- yes.

Q. I suggest to you that they did this at the down point of the descending trend as shown by the Canadian statistical summary; namely, in August of this year.

A. I saw the issues. I know about them.

Q. And I suggest to you that they paid coupon rate of 5 per cent, and that their yield on those bonds are now 5.2 per cent, and that the amount was 175 millions on that one issue. That is their long term issue?

A. Yes. Well, it is quite likely that any equipment trust bond might be financed at a lower price, especially if this was a shorter duration, as it almost certainly would be.

Q. Have you checked the Canadian Pacific files of '93?

A. Checked them? In what way?

Q. To see their current yield?

A. Yes, I think I looked at them, yes.

Q. Do you remember what the yield was?

A. They were above this level. I do not remember how much.

Q. I suggest to you that they are now, as of November 10, yielding 537. Would you accept that?

A. Yes, sir, I think that is correct.

Q. Are you suggesting that the Government of Canada, which gives an unconditional guarantee to Canadian National debt securities made a mistake and foisted upon the Government of Canada and the Canadian National Railways unnecessary charges by going for long-term debt at 5 and better than 5, when you say the Canadian Pacific could have got equipments at 4½?

A. Can get equipment trust at 4½ over the

next two years.

Q. You say that the Canadian National might well have waited and not raised such a large capital sum ---

A. No, I did not say so, sir. Whether any organization waits depends upon its present needs, and also on the probability of a decline or an increase in the future.

Q. Well, of course, the Canadian National, with the resources of Canada, can have advances from the government, and they do not have to commit themselves. So that, if you were right, that there is going to be equipments available for Canadian Pacific, without government guarantee at 4½, then, obviously, the Canadian National would be able to get them cheaper; wouldn't they?

A. Yes, sir. May I say a word about this. I was forced to make the best judgment on this matter that I could: the best judgment would be that there will be some reduction in interest rates over the next two years. I call the attention of the Commission to the fact that there is at stake a half of a per cent difference in this estimate, of exactly $80,000 over the two-year period, which is a very small item. I agree that I could be wrong in suggesting that interest rates may be lower over the next two years, but it is my best estimate at this time.

Q. In any event, they are now higher than when you wrote your paper, and they are ---

A. I was aware of this, I assure you, sir.

Q. You are pretty familiar with the railroads of the United States?

A. Yes, sir.

Q. You would agree that the New York Central and Pennsylvania in recent years both have been in serious trouble in their financial position and their financial returns have been markedly depressed?

A. Yes, sir.

Q. You also know the Chesapeake and Ohio has in recent years, in contradistinction, been financially strong?

A. Yes, sir.

Q. Now, for instance, taking 1958 as an example -- and I am using here the ICC statistics; the publication, ICC Statistics for 1958. Are you familiar with that publication?

A. Yes, sir.

Q. That shows that the Chesapeake and Ohio paid 5.42 per cent on shareholders' equity as shown by the book value equity. Do you accept that figure?

A. I just do not know it.

Q. Will you accept it subject to checking?

A. Surely.

Q. And I suggest on the same basis that in the same year the Pennsylvania paid on shareholders' equity 0.24 per cent. Do you accept that figure?

A. Well, again, I have not computed these. Subject to checking, certainly.

Q. Now, you would agree that these relative relationships have existed between the Pennsylvania and the Chesapeake & Ohio in recent years -- the Chesapeake & Ohio is strong, and the Pennsylvania is weak?

A. All right, yes, sir.

Q. I suggest to you, Dr. Ulmer, that in applying your concept as put in your paper for the determination of a permissive level of earnings this would result in what may determine the cost of money

for the Pennsylvania at about one-twenty-fifth of what it would be for the Chesapeake & Ohio?

A. Oh, no, sir. I would not estimate the cost of money of these firms on the basis of the behaviour in any short period. I have agreed that one railway, by and large, has been stronger than the other, but the Pennsylvania Railroad has paid larger dividends in the past than it is paying now. All this is relevant.

Q. Well, when did the Pennsylvania pay on shareholders' equity a dividend anywhere near that of the Chesapeake & Ohio? Just when, Dr. Ulmer; how many years ago?

A. I don't know.

Q. I suggest to you that they have not done so in the postwar period -- nowhere near?

A. Of course, I am not denying here that the cost of money to a concern, whether it is the Pennsylvania Railroad or the Chesapeake & Ohio, is determined in part by its financial structure. This does make a difference, and even an enduring difference, and, perhaps, of the magnitude that you are suggesting here. I hesitate to go along with you about this, sir, not because I have any doubt about the figures you are giving me but only because I have not analysed these two railroads from this point of view.

Q. Well, let us go to Canada. Let us get to right where the voting is done.

MR. MAURO: Where the what is done?

MR. SINCLAIR: I said "where the voting is

done". I can well understand that ---

MR. FRAWLEY: Is it the shareholders who are voting, or the people of western Canada who are voting? What is my friend talking about?

THE CHAIRMAN: Let us get on.

MR. FRAWLEY: I am willing to get on without this kind of nonsensical remark.

MR. SINCLAIR: Q. Dr. Ulmer, let us orient ourselves in the Canadian scene. That is what I was trying to convey to you. Do you know the Bell Telephone Company of Canada?

A. Yes, sir, I do.

Q. You have studied it?

A. No, sir.

Q. You know it is a regulated industry?

A. Yes, sir.

Q. You said this morning that you knew of no Canadian corporation that paid out 100 per cent of its earnings?

A. I did not say that, sir.

Q. You did not? What did you say? That you knew of none -- do you know of any large Canadian corporation that pays out largely all of its earnings?

A. I am aware of the fact that, generally, in Canada, the amounts of retained earnings are relatively not as great as they are in the United States. If this is the point, sir, I agree with you.

Q. The Bell Telephone Company is a regulated utility, regulated by the Board of Transport Commissioners

-- did you know that?

A. I was not sure as to which Commission regulated it. I realized it was regulated, of course.

Q. Now, in recent years it has been paying approximately 6 per cent on shareholders' equity. Do you know how the Bell Telephone capital structure, debt versus equity, compares that with Canadian Pacific?

A. No, sir.

Q. I suggest to you that it works out at about only a ratio of around 30-odd per cent debt -- approximately the same as Canadian Pacific. Now, under your method, when looking at Canadian Pacific in relation to shareholders' equity return and Bell Telephone's return, I suggest to you that it necessarily follows that what you are suggesting is that the cost of money -- what may be termed "the cost of money" -- for the Bell Telephone Company is about three times the cost of money to the Canadian Pacific by the very fact that it pays out approximately 6 per cent on shareholders' equity as compared to that paid by the Canadian Pacific?

A. I follow neither the logic nor the arithmetic of this, sir. My own estimate of the cost of money here was based on the relationship between the total permissive earnings including that which goes into fixed charges as a percentage of the total capital invested in these operations. It came to $3\frac{1}{2}$ per cent. I do not know these figures that you are giving me from the Bell Telephone Company -- I do

not know exactly what they mean here, and certainly the ratio does not seem to be three times.

Q. You are talking of pay-out?

A. That is a different matter, sir.

Q. I am suggesting to you that the pay-out under your method of earning is a material factor, and is the major factor in determining your level of the cost of money. You are not going to disagree with that?

A. You see, when you use a term such as "major factor" I am not at all sure what that means. It is a factor as it enters into the picture, yes, sir.

Q. I think there is no doubt about this, Dr. Ulmer, that it is the one you put as number one?

A. You equated the pay-out with the cost of money, and I certainly have not. You have the right to interpret this term in your own way, but not the right to suggest that I interpret it in that way, which I do not.

Q. I am going to suggest to you that if the Bell Telephone Company was restricted to a permissive level of earnings such as you suggest for Canadian Pacific, 3.15 per cent, its financial integrity would be impaired.

A. My figure is 3.5 per cent and not 3.15 per cent. I was not studying the Bell Telephone Company. I would have to appraise its financial structure before making an estimate, and it could very well differ from the estimate I have made in this case.

Q. Now, I put it to you that if the Board of Transport Commissioners in their regulation of the Bell Telephone Company are permitting it a return on investment of 6 per cent, while you suggest 3.5 per cent for the Canadian Pacific -- that if your views were accepted and applied to Bell it would put the financial integrity of the Bell Telephone Company in jeopardy?

A. I would not wish to apply it to Bell without knowing more about the situation than I know now.

Q. Bell is in a monopoly position in regard to telephone service in large sections of Canada. The telephone business is a monopoly business; is that correct?

A. Oh, yes, sir.

Q. And, therefore, the risks are not as great as in a non-monopoly business? We agreed on that this morning; is that correct?

A. In this case I would say: Yes. As you will remember I did not wish to equate a monopoly position with steadiness of income or safety. I think they are different things -- they are related, but different.

Q. But you would agree that drawing on the equity is possible in respect of a monopoly position whereas it is not possible in respect of a non-monopoly position, or corporation?

A. I think that any corporation can to some

extent make use of this technique -- large corporations.

Q. Would you agree with this -- I am reading from your book, Dr. Ulmer --

"Rewards for 'trading versus equity' in monopolistic industries, in which public regulation aims at a fair return on total investment, acquire in this way an extraordinary degree of security which cannot be approached in other sectors of the economy."

A. There is a difference in degree, yes, sir.

Q. It is the difference in degree -- is that your answer?

A. Oh, yes, it is a difference in degree.

Q. Now, Dr. Ulmer, you have suggested that the Canadian railways are not in need of substantial amounts of capital, and can meet their capital requirements largely through internal financing?

A. I did not say that the railroad would not need substantial amounts of capital. I think, again, this is misquoting my report.

Q. Are you suggesting that ---

MR. MAURO: Did you want to say something else, Dr. Ulmer?

THE WITNESS: Yes.

MR. MAURO: Let him finish, then.

THE WITNESS: I think I know what I wrote. I did say that it did not need, or need not necessarily

have a need of, substantial amounts of outside capital. Certainly, if the permissive earnings which I have suggested here were in fact realized there would not be a need for any outside capital.

MR. SINCLAIR: Q. I will put my question to you again. I said you suggested that the Canadian railways, and Canadian Pacific in particular, are in need of substantial amounts of capital, and can meet their capital requirements largely through internal financing.

MR. FRAWLEY: Are you quoting from the witness's report or are you putting some interpretation on it? That is what the witness asks you. Perhaps you are not quoting it word for word. If so, perhaps you would not mind saying so.

MR. SINCLAIR: "Under such circumstances", says Dr. Ulmer ---

THE WITNESS: What is the page?

MR. SINCLAIR: Q. Page 9.

"Under such circumstances, the need for 'attracting capital,' so emphasized in the C.P.R. memorandum, is minor, if it exists at all."

And then you develop your Tables 6 and 7 to indicate, according to you, first in the United States and then in Canada the needs for capital were not large in relation to investment, obviously, and that they could be met largely in relation to internal sources.

A. If you turn just to the sentence before

that it will be apparent to all, including the Commission, that I was referring to the great mass of internal financing in the past. I did not say the capital requirements would not be great; I said they have been met largely in the past by internal financing, and they could conceivably be met in that way in the future.

Q. Is it your position, Dr. Ulmer, that the Canadian railways do not require large capital expenditures which must be raised from external sources?

A. That is the point -- external sources. I have said this is not necessary, and has not been necessary in the past.

Q. And you base that on your Table 6 by having a look at the United States railroads?

A. In part.

Q. I beg your pardon?

A. I say I base it in part on that.

MR. FRAWLEY: Table 6?

MR. SINCLAIR: Table 6 is the United States railroads, and Table 7 is the Canadian Pacific, Mr. Frawley.

Q. Now, Dr. Ulmer, you are equating the situation in Canada and the United States as based on your studies, I take it?

A. No, sir. I looked at the record of the Canadian Pacific Railway Company to see whether its situation was similar to that of the average situation in the American railroads, and I found that it was in this respect.

Q. In this respect?

A. Yes.

Q. Has the additional capital formation of the Canadian Pacific paralleled that of the United States railroads since 1948, say?

A. The question under review -- I simply narrow this particularly to make known the meaning of the word "paralleled" in this case. I was comparing the reduced internal financing in the Canadian Pacific Railway with that in the United States railroads. I did find that in that case there was something approaching a parallel. They were not exactly the same, but the same general pattern was there, yes, sir.

Q. My question, Dr. Ulmer -- and you will have to pardon me for looking at these things in the way I do look at them, and for my testing your views in a different way from those of other people. Your answer is not responsive. I am asking you this: Is it your position that the capital additions to Canadian Pacific in the period, say, since 1948 have paralleled those of the United States railroads?

A. I might have to say: "I do not know" to this, but will you tell me what you mean by "paralleled"? Do you mean that the rates of investment are at about the same rate -- the volume of investment?

A. That is right.

In both cases they both increased substantially in this period.

Q. And do you think at the same rate, generally

speaking?

A. I really am not sure.

Q. I am suggesting to you that the statistics will show -- and these are the published records of the Canadian Pacific's net investment in rail in the period from 1948 through 1959 -- that it has increased from under $1 billion to over $1.4 billion, an increase of some 44 per cent. In the same period the net investment of railroads in the United States, from published statistics, has only increased by 16 per cent. Are you surprised at that?

A. No, there is a great diversity in the American railroads, and in the east and the west there are rather different situations.

Q. So there has been a marked difference of the paralleling of the capital investments, United States railroads versus Canadian Pacific?

A. On this relative basis, yes, sir.

Q. I suggest to you that to determine the need for the capital that Canadian Pacific requires you have to know something about the possibilities of the Canadian economy, and its need for rail services. Would you agree?

A. Yes, sir.

Q. I suggest to you that the economy of Canada in the next years, in its need for railway service, will be markedly different from that of the United States, with Canada having substantially more rail transportation requirements than the United States?

Would you agree?

A. I would certainly say that this is possible.

Q. And as a result of these extractive industries, particularly in western Canada, large capital requirements will quite possibly, and probably likely, have to be met?

A. Large capital requirements in mining enterprises?

Q. No, for rail to meet the extractive industries' demands.

MR. FRAWLEY: Not for oil or gas.

MR. SINCLAIR: My friend, who is an expert on oil and gas, may be surprised to know that Alberta's requirements from its gas industry for rail transportation are one of the greatest because of the fortunate position his province is in in having sour gas and sulphur, and the very large amounts of sulphur to be moved by rail must be projected.

MR. FRAWLEY: All I know is that there are vast amounts of capital made available to build pipe lines, not only out of Alberta but all over Alberta.

MR. SINCLAIR: Dr. Ulmer, your experience in transportation is that sulphur is not moved by pipe line, yet? That is right, is it not?

A. I would like to say, sir, that you are suggesting there is a greater opportunity now, or a need, perhaps, for an extension of the Canadian Pacific Railway's facilities. My review of the company suggests

that it has been a long time since there has been any great substantial expansion of its services.

Q. Based on its capital requirements ---

A. Based on your investment.

Q. Based on our capital investment year by year?

A. Now, the size of your business, which you have quoted earlier, reflects to a considerable extent the price increase. The new capital units you have purchased have been of a much higher value than those which they replaced. This increase in the assets of the figure you gave us of 40 per cent does not mean a 40 per cent increase in the physical facilities of the Canadian Pacific Railway.

Q. Of course not. I am not suggesting that it was, but I suggest this to you, Dr. Ulmer, that you had available to you a ready reference as to the possible requirements for rail transportation capital in a Canadian environment if you had taken it, and that was to take a look at the Canadian National Railways and what they had spent and were authorized to spend on capital in recent years. Do you know what this is?

A. How much it has been authorized to spend on capital in recent years? No, I cannot say I do.

Q. Do you know how much it was authorized to spend in 1959 or 1960 -- take the last couple of years as an average?

A. No, I did not consider the Canadian National Railways; only the Canadian Pacific Railway.

MR. FRAWLEY: I do not know what the Canadian National's figures are that my friend is referring to, and I think if he is putting these kinds of questions to the witness he should call the attention of the witness to the distinction between the Canadian National Railways which are owned by the people of Canada and which are asked, and expected, to build pioneer lines here, there and any place else, and the Canadian Pacific Railway which is a private enterprise and which is not called upon to do that sort of railroading.

MR. SINCLAIR: I am very much surprised that my friend wants to give that evidence, and to say that the Canadian National Railways are required to build pioneer railway lines, because the president of the C.N.R. has made it abundantly clear that when he builds a railroad he builds it only after a guarantee. He has built one in the maritime provinces ---

THE CHAIRMAN: In Quebec.

MR. SINCLAIR: I am sorry -- in Quebec where he is getting paid for it, because the anticipated traffic has not developed and is not moving over it. Another example is in the province of Manitoba with respect to the Lynn Lake and Moab Lake developments of the International Nickel Company. These are the facts, notwithstanding the interpretation Mr. Frawley would like to put on them.

MR. FRAWLEY: It is owned by the people of Canada, and Parliament has a lot to say about what Canadian National does.

MR. SINCLAIR: I am glad he has made that point because it points up something that I really wanted to bring to Dr. Ulmer's attention, and that is that the Canadian National Railways are owned by the Government of Canada, and, therefore, they have an ability to get funds which are not limited by the cash in the till of the railway.

Q. You knew this, Dr. Ulmer? Therefore, t h e i r not being so limited with respect to their capital requirements gives you a readymade guide as to capital requirements in an industry to meet the country's rail transportation needs. Would you agree with that?

A. That Canadian National provides us with a guide as to what the railway needs are, and as they are to be satisfied by the Canadian Pacific?

Q. As they are to be satisfied in the Canadian environment?

A. Part of the experience is relevant, yes, sir.

Q. Therefore, I suggest to you that you should have recognized that the capital formation of Canadian Pacific, and its source, could be adversely affected by the ability of the company through its lack of earnings. It would be quite proper and possible for you to come to that conclusion?

A. That your company has been handicapped by its lack of earnings?

Q. Yes.

A. This is a possibility at all times for any company.

Q. Before I put this next question, have you any idea in your mind of the relative position, size of plant by virtue of miles of track, or gross earnings, Canadian National against Canadian Pacific?

A. I have not studied the Canadian National, sir.

Q. I mean the Canadian scene. I am talking about the Canadian scene. These are the two major railways. They do ninety per cent of the rail transportation in Canada. Have you any idea of the relative size of them?

THE CHAIRMAN: Which is the bigger?

MR. SINCLAIR: I wonder if he would accept a 60-40 relationship -- 60 for Canadian National, and 40 for Canadian Pacific.

THE CHAIRMAN: Which is the more important?

MR. SINCLAIR: With respect, Mr. Chairman, I do not think that is the kind of question I am putting at all. I say that with all due respect. I must say, sir, that this type of examination is difficult enough for a person without having it diverted.

MR. FRAWLEY: It is not difficult for the Vice-President, Law, of the Canadian Pacific Railway, and I say that in all seriousness.

MR. SINCLAIR: Q. Let me go back, Dr. Ulmer -- I suppose my friend means that well. Dr. Ulmer, would you accept on the basis of railway revenue and

capital a relationship of 60-40?

A. If I was concerned with this I would look it up, sir, but I am not concerned with the relative size of the two railways.

Q. Well, I am going to suggest to you that -- I want you, if you will, to accept that relationship 60-40?

A. Are you suggesting that this is the relationship? I do not wish to engage in a guessing game. If it is, and I am your authority, I will certainly accept it.

Q. Very well. Well, Canadian National have capital formations of 230 millions in the last two or three years; and if you apply that 60-40 relationship to Canadian Pacific, under that basis it would require very much substantially more money than is set out in your table 7; you would agree to that?

A. I did not set out any particular number of requirements in table 7, sir. This is a table of percentages.

Q. But it reflects a certain level of capital expenditure?

A. Of the past, yes, sir.

Q. Yes. Let us take 1958 - 1959; 1957 through 1959.

A. Yes.

Q. You know what the Canadian Pacific spent in 1959 in capital?

A. Yes, I do.

Q. What was it?

A. The figure was something like 72 million.

Q. 72.4?

A. Yes.

Q. Well, I am now giving you a relationship. I have given you a relationship that would indicate a much higher expenditure by taking 230, and the relationship of 60-40, Canadian National, Canadian Pacific.

A. I simply would not accept that analysis, sir.

Q. Let me suggest this to you: say that the Canadian Pacific, instead of spending 72, 73 millions on capital, has spent 150 millions, to keep it in relationship to, for instance, the capital formation of the Canadian National.

A. Is there any need for it to be in the same relationship, sir?

Q. It is serving the same general Canadian situation.

MR. FRAWLEY: Of course, you see, there you are again, sir. My friend is making statements of facts about what the Canadian National serves in this country, and what the Canadian Pacific serves. With all due respect, that is far too complex and important a question to be wrapped up in one matter, in one short question to be thrown at Dr. Ulmer.

THE WITNESS: I certainly have not studied this question.

MR. SINCLAIR: Q. Assume with me we will take a situation that the Canadian Pacfic, instead of spending, say, $75 million dollars, required capital formation of double that amount. Assume that with me?

A. All right.

Q. Now, you might, if you would, tell this Commission what in your judgment would be the source of that additional $75 million?

A. This is a huge figure. Now, the $72 million that we started out with is a figure which is covered to the extent of some 50 some odd million dollars by depreciation charges against current earnings.

Q. That is right.

A. And, now, on top of this remainder of $16 million dollars you are tossing an additional $75 million. This is a tremendous sum.

Q. You think ---

A. I am not sure that I am able to solve this financing problem, or that you will find many people who can do it with great ease.

Q. Let us make it a little easier. Instead of spending in 1959, 75 million (for purposes of round figures), it spent 125 million. Where do you think the Canadian Pacific would be able to raise that extra 50 million?

A. I do not think it is --- I do not know. I do not think it is probable that there will be any such tremendous increase in the requirements, the capital requirements of Canadian Pacific Railway. At least, there has been nothing in its immediate past to suggest this.

Q. Dr. Ulmer, I suggest that in one of the years that you are dealing with, 1957, the capital

expenditure of Canadian Pacific was 127 million, which is exactly the figure in the area of which I put this last question to you. Now, does that startle you?

A. No, I was aware that there had been substantial investments in previous years.

Q. But you do not think they will occur in the future, as they did as late as 1957 on Canadian Pacific? Is that your judgment?

A. I did not think this was likely.

Q. What do you base that on -- your knowledge of Canadian Pacific and of the Canadian economy?

A. My knowledge of the current trends in investment, yes, sir.

Q. The knowledge ---

MR. MAURO: Let him answer.

THE CHAIRMAN: Mr. Sinclair, I think we will get on much quicker if there is no provocative questions or provocative tone of voice.

MR. SINCLAIR: Well ---

THE WITNESS: Thank you, sir.

MR. SINCLAIR: Well, Mr. Chairman, with all due respect, I do not know if I can ask the witness or test him other than by asking him provocative questions.

THE CHAIRMAN: It depends on the manner in which they are asked.

MR. SINCLAIR: Very well, Mr. Chairman. When somebody comes forward here and presents evidence to try to destroy the financial integrity of the Canadian

Pacific, I certainly am going to test his knowledge and qualifications.

MR. FRAWLEY: Having said that ---

MR. SINCLAIR: But -- but -- I am talking to the Chairman ---

MR. FRAWLEY: When you are finished, I will say something.

MR. SINCLAIR: But, sir ---

THE CHAIRMAN: Mr. Sinclair, there is no purpose in your fighting everybody in this room. We are here to try to solve a problem, and that we are trying to do.

MR. SINCLAIR: Very well, sir.

THE CHAIRMAN: And I hope we have your help.

MR. SINCLAIR: Very well, sir, I will ask the witness three more questions and close my cross-examination, then, in view of your ruling.

MR. FRAWLEY: Just a minute, Mr. Chairman. The record now shows, Mr. Chairman -- Mr. Chairman, I have been accused on behalf of Alberta of having attempted to destroy the integrity of the Canadian Pacific Railway. I am here for the government of Alberta and I say my friend is talking complete nonsense when he talks like that. I have come here to defend the people of western Canada against an allegation that the Canadian Pacific lost in 1958 35 million dollars, and in Crow grain. I am here to defend my people against that allegation, and this is one of the men that we have got to help us to do that.

I am not attacking the integrity of the Canadian Pacific Railway and my government would not do it. I stand here representing the government of Alberta, and the government of Alberta is not doing it, and I am not doing it, and I want no such statement on the record.

THE CHAIRMAN: Let us get back on the rails again.

MR. SINCLAIR: I never thought I was off them, sir, but I accept the fact that possibly others did.

THE WITNESS: Mr. Chairman, I was about to respond to the most recent remark preceding this to which counsel has made reference, and I did not get a chance to do so. I wish to make this clear that I made no effort here to engage in a specific -- which is impossible -- a specific prediction of the investment that is going to be required by the Canadian Pacific in each and every year in the future.

I have taken the current investment requirements of the Canadian Pacific Railway, and have said that on this basis there are certain permissive earnings that may be definite, which is a very different thing from saying that I know definitely what I do not know -- that some aspects of the situation may change dramatically in the future when and if these things arise, and, of course,one must make a re-appraisal of this situation, or of any other.

MR. SINCLAIR: Q. Are you through?

A. I certainly am, sir.

Q. I will ask you this, Dr. Ulmer. Do you

think that Canadian Pacific can attract capital when, under your basis of permissive level of earnings you have resulted in having a return on shareholders' equity at lower than the return on risk-free government of Canada bonds?

A. I do not think this is a relevant comparison, sir, if I may say so.

Q. How theoretical can you be?

A. Ah, no. The relevant thing is how much you are paying in connection with your financial obligations -- with your financial obligations. That is, you have got a six percent return or more on the common stock of the Canadian Pacific Railway. How much can be paid on any new capital securities that may be floated or issued, if this is required. Under my own analysis, the result was achieved that no need for outside capital would be present under the circumstances that have been, up to this moment, prevailing in the Canadian Pacific Railway.

Q. Dr. Ulmer, on your basis of what the return on shareholders' equity -- on your basis of 3.5% over all return, what is the return on shareholders' equity on Canadian Pacific?

A. Well, you see, what I thought was the relevant matter was the return that was permissive here on the outstanding common stock.

Q. Oh, that means that you do not think that retained earnings should earn a return. Is that your position?

A. No, that is not the position. There must be an overall return for the firm which is in the aggregate sufficient to meet the obligations, the financial obligations of the Canadian Pacific Railway, as well as under the circumstances prevailing in 1958, its capital requirements. This is what my earnings do.

Q. Dr. Ulmer, would you agreed that the railways in particular should be allowed to earn a reasonable rate of return where their services are economically justifiable if they are to finance their needed capital expenditure?

A. I would say that the returns that may prevail on the accumulated surplus of the Canadian Pacific Railway is not a necessary index on whether it can attain the capital sufficient for its requirements.

Q. May I ask you again would you agree that the Canadian Pacific Railway should earn, should be allowed to earn a reasonable rate of return where their services are economically justifiable, if they are to finance their needed capital expenditure?

A. Certainly, the corporation should be allowed a reasonable rate of return after allowance is made for its financial structure. I think this is a very relevant point.

COMMISSIONER GOBEIL: Mr. Sinclair, may I ask you a question. How much money did you say that the Canadian Pacific Railway borrowed in 1957?

MR. SINCLAIR: No, capital -- the capital expenditures for that year were 127 million.

COMMISSIONER GOBEIL: Yes.

MR. SINCLAIR: Capital expenditure.

COMMISSIONER GOBEIL: Yes, and Dr. Ulmer, you believe that this cannot be repeated?

THE WITNESS: With the particular capital requirements of that year?

COMMISSIONER GOBEIL: Yes.

THE WITNESS: Oh, yes, they could be repeated. I wanted to deny that suggestion that I was presuming to predict the capital requirements of the future for the Canadian Pacific Railway in every year of the future. What I have done here is taken the existing situation and under these circumstances attempted to define the total aggregate amount of earnings that was justified.

MR. SINCLAIR: Q. And you have agreed with me, Dr. Ulmer, that Canadian Pacific should have a fair return on the capital employed, and I now want to ask you if you would agree that the test of what that fair return should be would be a return as large on the capital invested as would be received in similar enterprises having similar risks and uncertainties.

A. No sir, I would not consider this a sufficient standard. I would want to know about the financial structure of the corporation to which reference was made and the financial structure of other corporations. Actually these rates of return differ quite markedly.

Q. But assume with me that the financial structure is proper in relation to debt equity, then would you agree the test I have given you is the correct test?

A. No sir, I am not sure what "proper" is and also very relevant here is the quantity of accumulated surplus.

Q. Dr. Ulmer, are you suggesting that because one company decides to adopt a low pay out ratio and another company decides to adopt a high pay out ratio that because of that fact the test of what the company should earn on its investment is affected?

A. Oh, yes sir, I would.

Q. You would suggest the one with the low pay out ratio, that the return should be less than the one with the high pay out ratio, is that what you mean?

A. I think yes distinctly in a corporation of this kind this is so.

Q. So what you are proposing is that a company like Canadian Pacific should follow, if it wants to increase its permissive level of earnings,

a high output ratio and do external financing rather than internal financing?

A. I would not presume to suggest what the managers of Canadian Pacific ought to do.

Q. But this would be the result if the policy of high output ratio and resort to external borrowing, under your approach, by that fact the permissive level would increase?

A. I am not attempting to define the permissive earnings that the Board of Transport has jurisdiction over. I am not stating a policy for regulation of this company and I do not wish to express opinions on this.

Q. But you are trying to equate permissive level of earnings and trying to equate the earnings under that plan with what might be termed the cost of money on equity capital, are you not?

A. Yes sir, I am.

Q. I suggest you must, if that is what you are trying to do, turn your mind to the questions I have put to you, questions as to the fact of output that under your plan on equity the very fact of a high pay-out on Canadian Pacific and external financing would automatically under your method increase what you term the cost of money to the corporation?

A. It is not necessarily so. You see, if you did resort to more external financing this would undoubtedly increase the capital charges so there would be a need for earnings to meet this. On the other hand,

if your earnings were down to your capital requirements and an assumption that a proportion of that was going to be plowed back into the concern this allowance for retained earnings is also an increment to earnings and it is not easy to answer your question without knowing the specific arithmetic involved.

Q. You put some specific arithmetic on it by coming to a determination of permissive level of earnings based on a surplus of $17 million dollars.

A. Oh yes, I certainly did and I would be glad ---

Q. And I suggest ---

MR. FRAWLEY: Let him finish.

THE WITNESS: I would be glad to compare it with the analysis that the CPR has submitted in this regard -- I do compare it.

Q. I suggest to you that you must add that figure to the amount that you suggested should be earned on stock and then adding the two together relate that to shareholders equity give you a return. Would you agree that was the way you get a return?

A. Are you asking me how I figured my return because I will be very glad to tell you.

Q. I am working from your paper and asking you if I take the retained earnings from the surplus earnings and add that to the amount that you say should be permissive on stock and relate that to the shareholders equity that gives you the return on equity capital in the enterprise?

A. Yes, sir.

Q. And I suggest to you on that basis that it is substantially below 4%?

A. Yes, sir.

Q. And I suggest to you that you could not borrow a nickle's worth of money even if you were the Dominion of Canada on long term at the present time for what you say is a fair and reasonable level for Canadian Pacific equity -- net debt?

A. Yes. Bear in mind, however, that these earnings are sufficient to allow a 6% return on the common stock and, of course, it is within the option of management to even increase the dividends with the amount of money allowed for additions and improvements -- all this money is not necessary for that.

Q. Dr. Ulmer, have you ever been an adviser on financial matters to any regulatory tribunal?

A. Yes sir, I have.

Q. It is not listed in your qualifications. What regulatory tribunal was that?

A. Well, I have -- you say "regulatory", I have been an employee of the Department of Commerce concerned with financial matters.

Q. I said a regulatory tribunal and the Department of Commerce is not a regulatory tribunal, is it?

A. No sir, this was the phrase that skipped me.

Q. I will put it again: have you ever been a financial adviser to any regulatory tribunal?

A. No, sir.

Q. Have you ever been a financial adviser to a Canadian corporation in the public utility field or any other industrial field?

A. No, sir.

Q. Have you ever given evidence on finance or the cost of capital on any proceedings?

A. I have given evidence for the General Service Administration and the I.C.C. in the United States. This did not bear precisely on this matter of cost of capital, it did bear on certain financial matters.

Q. But not on cost of capital?

A. That is right.

Q. And any proceedings other than this one, have you ever testified on permissive level of earnings?

A. No, sir.

Q. How long, Dr. Ulmer, have you spent in Canada or in the study of Canadian industrial corporations, say, in the last year?

A. In the last year this has been my only visit here.

Q. Well then, within the last two years -- a relevant period, the last five years?

A. How much time have I spent here? I have been here on brief visits and that is all.

Q. On the basis of studying financial corporations?

A. No sir, I have not studied financial matters here in Canada.

MR. SINCLAIR: That is all, Dr. Ulmer.

THE CHAIRMAN: We will break now.

--- A short recess ---

THE CHAIRMAN: Have you any questions, Mr. McDonald?

MR. McDONALD: No. I think the subject has been very adequately covered by Mr. Sinclair.

RE-DIRECT EXAMINATION BY MR. FRAWLEY:

Q. Dr. Ulmer, I just want to draw your attention to a figure on page 11 of your memorandum in which you estimate the permissive earnings for the C.P.R. to be $50,745,951?

A. Yes, sir.

Q. And that was using what year?

A. That was using the year 1959.

Q. I want to call your attention to some figures on page 12 of the Decision of the Board of Transport Commissioners dated November 17, 1958, which is the Decision in the Case commonly called the 17% Case, and I would ask you to say whether you agree with me that the Board on that page of that Judgment referred back to its Judgment of December 27, 1957 and said that the amounts found in the Judgment for the permissive level of earnings totalled $51,203,000?

A. Yes, sir.

MR. SINCLAIR: I think counsel might also draw to the attention of the witness that the level of permissive earnings for Canadian Pacific was specifically under reserve in that Judgment.

MR. FRAWLEY: All I say is that the Board said in its Judgment of November 17, 1958 -- they

simply made a statement which was a statement of fact that in the Judgment of 1957 the amounts were -- I will read them all. They total $51,203,000 ---

MR. SINCLAIR: All I am asking, Mr. Frawley -- and I know from old that you would like to do this -- is to go to page 19 of the same Judgment and read the words:

> "The level of Canadian Pacific's financial requirements will be reviewed by the Board when considering the part of the application requesting final relief . . ."

MR. FRAWLEY: Well, I can say quite clearly that there is now pending before the Board of Transport Commissioners, and adjourned indefinitely because of the policy of the federal government that there are to be no further applications for freight rate increases to the Board pending the work of this Commission, an application of the Canadian Pacific, but I am well aware that at the moment Canadian Pacific would like to have the permissive level of earnings reviewed, and that they have an application before the Board for that purpose. I am simply drawing the attention of the witness to the fact that he comes out with an estimate of $50,745,000-odd, whereas the findings of the Board of Transport Commissioners, in its Judgment of December 27, 1957, give that figure as $51.2 million. The figures are so close that they remind me of Mr. Kennedy's popular vote in the United States on last election day.

Q. Now, Dr. Ulmer, were you asked to take part in these proceedings and these submissions to the Board as a part of the submission and the studies being made by Mr. Banks?

A. Yes, sir.

Q. And were you aware that your memorandum or study was to complement the study being made by Mr. Banks?

A. Yes, sir.

Q. The studies which he presented to the Commission yesterday?

A. Yes, sir.

Q. Were you asked, or did you make any attempt, to prescribe a new level of permissive earnings for the Canadian Pacific Railway in its dealings before the Board of Transport Commissioners?

A. Of course not, sir.

Q. And you made no attempt to do anything of that sort?

A. No, sir.

Q. And were you aware that Mr. Banks intended to use, and did use, a figure of 3.5 per cent when he was endeavouring to arrive at a cost of money as an expense item for finding out how much it cost the Canadian Pacific in 1958 to move grain to export positions in western Canada?

A. Yes, sir.

Q. And you were aware that the figure you have given him underlies the expense item covering cost

of money which Mr. Banks has used and has presented to this Commission?

A. That is true, sir.

MR. FRAWLEY: That is all, thank you.

THE CHAIRMAN: Mr. Balch, have you any questions?

COMMISSIONER BALCH: I have no questions.

COMMISSIONER GOBEIL: I have no questions.

COMMISSIONER ANSCOMB: I have no questions.

COMMISSIONER MANN: I have no questions, but I do want to say this, that this is an extremely difficult subject, and one cannot help but be impressed by the agility with which counsel examining and counsel cross-examining, moved through a rather difficult field. Thank you very much for coming to see us.

THE WITNESS: Thank you very much.

MR. CUMMING: I do not think there is anything more, Mr. Chairman.

THE CHAIRMAN: What about those submissions of Mr. Saunders?

MR. CUMMING: I understood there was some suggestion, in view of the date which was set for this cost conference which I believe Mr. Saunders is attending, that the balance of the Saunders material would be taken as read. I understand that to be the case, and if I am correct in that then this might be an appropriate place for the reporters to take into the record the remainder of the Saunders material,

being Part I from page 99, and Part II. They can go into the record at this point.

THE CHAIRMAN: Is that agreeable?

MR. McDONALD: It is all right with me, sir.

MR. SINCLAIR: Yes, I understood that that had been arranged between Mr. McKimmie and Commission counsel.

MR. CUMMING: Yes. In the absence of my friends Mr. Cooper and Mr. McKimmie I suggest this material be taken in as of now.

THE CHAIRMAN: Then, on Monday morning we will have Mr. Edsforth who will be cross-examined by Mr. Mauro and Mr. Frawley, and then we will have Mr. Dingle and Mr. Hart here when he is finished. Then, on the 17th we will have Mr. Wesson, and then Mr. Brown, M.P., who is also presenting a brief.

Please insert this sheet between pages 19421 and 19422 in Volume 117.

P R E C I S O F E V I D E N C E

Submitted to The

ROYAL COMMISSION ON RAILWAY TRANSPORTATION IN CANADA

on behalf of

The Following Grain Marketing Organizations

ALBERTA WHEAT POOL

MANITOBA POOL ELEVATORS

SASKATCHEWAN WHEAT POOL

UNITED GRAIN GROWERS

THE PROBLEMS OF THE CANADIAN RAILWAYS

VOLUME 1

A GENERAL APPRAISAL

(Continuation of Submission, commencing at page 99 of Precis - "Station Costs").

Station Costs

The cost of station work is an important element in the passenger function. The CPR has made special studies which show the importance of the passenger services performed by station employees in the West. The study was made on a sampling basis with full coverage for large stations and lesser coverage for the smaller stations. The results of the sample data are shown in Table VIII - 9 where the percentage distributions of time and payroll are recorded by size classes.

Table VIII - 10 has been computed based on the foregoing, weighted to reflect the relative importance of the different size groups. This table shows the great importance of the passenger function. The direct handling of passengers and express accoun ed for 28.1 per cent of the

Table VIII - 9

Canadian Pacific Railways

Distribution of Payroll Time
at Sample Stations in the West1/

Type of Service	Size of Station; Number of Employees Over 10	2 - 10	1
	(Percent of total time)		
Grain	8.7	8.7	18.6
Other Carload	26.8	16.0	13.2
LCL	32.0	18.4	19.8
Express	0	6.7	21.5
Passenger Service	30.1	16.2	10.2
Train Operation	2.0	19.5	7.1
Commercial Telegrams	.4	9.8	9.6
IDP	0	4.7	0
Total	100.0	100.0	100.0

1/ Based on spring and summer of 1959, weighted by payroll for 1958.

Table VIII - 10

Canadian Pacific Railways

Distribution of System Station Costs Among Service Functions, Based on Special Study of Western Stations
Year 1958 1/

Type of Service	Total Earnings Amount	Percent
Grain	$ 3,496,267	10.3
Other Carload	7,196,199	21.2
LCL	8,757,638	25.8
Express	1,900,883	5.6
Passenger Service	7,637,475	22.5
Train Operation	2,817,380	8.3
Commercial Telegrams	1,629,328	4.8
IDP	509,165	1.5
Total	$ 33,944,335	100.0

1/ Accounts, 372, 373 and 376.

payroll. This is almost as important as the time spent on total carload business which represented 31.5 per cent of the total payroll cost. It is but little greater than the 25.8 per cent devoted to LCL traffic. This last is a subject which will be dealt with in the next chapter where it, too, will be shown to represent some special burdens for the railways.

This important study has been used in the next section of this Chapter. Conceptually, it is different from the regression studies used by CPR in its new costing procedure. The latter would produce much lower station costs chargeable to passenger service on an out-of-pocket basis. The Canadian National has regression studies which would charge no station costs at all to passenger service. This illustrates some of the difficulties in regression methods. In general, however, the special study probably produces some overstatement of the station expenses which would be eliminated if passenger service were abandoned.

The ultimate effect of all operating results and all changes in revenue is to be reflected in terms of the net earnings.

The Deficit Exists

The passenger problem is indeed serious on Canada's railroads. It produces sizeable operating losses on both the CPR and the CNR. Available data permit the application of the so-called "Crow method" of costing for much of the operation. This is the method used by the railroads in calculating the out-of-pocket and full cost of grain moving under statutory rates. The techniques used by the railroads can be applied to

the passenger service with only a relatively small number of assumptions. These assumptions are not sufficiently important to invalidate any of the fundamental conclusions to be derived from the data.

Deficits on the C P R

Including express, dining, buffet and other miscellaneous revenues, the passenger service on the CPR produced $63 million in 1958. Table VIII - 11 shows the components of the passenger service cost. Total out-of-pocket cost was $106 million and the out-of-pocket deficit was therefore $43 million. If constant costs are included, an additional $32 million must be charged. Thus, the deficit on a full-cost basis is at least $75 million. Even on the basis of variable operating expenses alone, without any allowance for cost of money or constant costs, the CPR has a passenger service deficit of nearly $24 million based on the results for the year 1958.

The deficit under full costs represents the burden on the total earnings of the CPR because passenger service does not pay its pro-rata share of all indirect costs and further that it does not contribute a profit margin to cover the capital costs associated with passenger service.

C N R Passenger Deficit

A similar study was made for the Canadian National Railway and the results of this study are also shown in Table VIII - 11. Total revenues from the passenger service on the CNR are slightly greater than on the CPR, amounting to some $66 million. The out-of-pocket

Table VIII - 11

Components of Passenger Service Costs, 1958

	CPR	CNR
	(millions of dollars)	
Total revenue	63.3	66.1
<u>Out-of-pocket cost</u>	106.0	168.4
Operating expenses	86.9	135.1
Passenger car repairs	11.9	18.8
Passenger car depreciation	3.6	4.2
Station operation	10.2	14.2
Train crew wages	10.4	14.8
Train fuel and power	5.7	7.8
Operating:		
Sleeping and parlour cars	5.4	5.1
Dining and buffet service	5.1	4.9
News services and restaurants	3.3	.1
Servicing passenger cars	4.4	
Other train supplies and expenses		9.8 1/
Other direct expenses	14.0 2/	39.6
Overhead expenses	13.0	15.9
Cost of money	19.1	33.2
Passenger cars	8.5	16.4
Other equipment	6.7	11.0
Roadway	3.9	5.9
<u>Constant cost</u>	32.1	78.0

1/ Servicing passenger cars and other train supplies and expenses combined.

2/ Other train supplies and expenses and other direct expenses combined.

Note: All figures include pro-rata share of passenger portion of cost of handling non-revenue freight. CPR: $2.8 million; CNR: $5.7 million.

costs, however, are much greater on the CNR - $168 million. Thus, on an out-of-pocket basis, while the CPR has a deficit of about $43 million, the CNR has a deficit of $102 million.

Even if we confine the analysis to expenses and leave out any allowance for cost of money, the deficit amounts to $69 million on the CNR as compared with $24 million on the CPR. If constant costs as well as cost of money are included, the CNR passenger deficit reaches the staggering sum of $180 million in 1958.

Table VIII - 11 also shows the relative importance of the various cost components. It can be seen that only a very minor portion of the out-of-pocket expenses is in the indirect or "overhead" category. Even disregarding these outlays, Canadian railway passenger services are conducted at substantial deficits.

Comparing the amounts shown as "other direct expenses" for the two railways suggests that the CPR costs of $14 million are understated. The $10 million of station operation probably exceeds the amount used by the CPR in its costing studies. Even allowing for this difference, the "other direct expenses" estimated by the CPR would still be no more than $20 million. This amount should cover maintenance of roadway, buildings and equipment, other than passenger cars, all yard expenses, and train operation costs, other than wages, fuel and car servicing. It corresponds to something over $40 million on the CNR (allowing for some train supplies and expenses). This is a tentative conclusion, however, which cannot be confirmed until we receive further details underlying the CPR cost studies.

The CNR passenger costs shown in Table VIII - 11, in turn, are thought to be conservative, as they contain no allowance for property taxes, and insufficient amounts for pensions and unemployment insurance taxes.

It can now be seen whether the cost-revenue relationships foreseen from the analysis of revenue and physical characteristics are as expected.

Table VIII - 12

Ratio of Expenses to Revenues in Passenger Service, 1958

	CPR	CNR	U. S.
	(millions of dollars)		
Expenses	110.9	193.3	1,812.5
Revenues	63.3	66.1	1,178.0
Ratio, Expenses to Revenues	1.75	2.92	1.54

The costs in Table VIII - 12 are confined to expenses, no statistics on U. S. cost of money being readily available. They show CPR expenses to exceed revenues by 75 per cent compared to 54 per cent on U. S. lines. CNR expenses are nearly triple the revenues. If allowance is made for the probable understatement of CPR expenses, the CPR relationship might be more nearly two to one. The addition of cost of money would, of course, raise all of them considerably.

The interpretation of these ratios is that the burden of passenger service on the railways and freight shippers in Canada as compared to the U. S. is much greater than would be indicated by the relative importance of passenger revenues.

Sources of the Deficit

The foregoing shows that substantial sums are involved in the passenger service deficits. However, the passenger service is made up of a great many functions and it is well to inquire into the various components of the service. The railroads have made available no studies in this connection. Some rough approximations of the magnitudes involved can be made by analysis of the operating statistics of the carriers and by making certain assumptions about the relative cost of certain functions. For example, the reports do not distinguish the maintenance expenses for the different types of passenger train cars. Studies have been made in the U. S. which have developed the relative cost per car-foot mile for different types of equipment. Factors of this type have been applied to the Canadian data in order to make apportionments where needed. The results of this analysis are contained in Table VIII - 13 for the CPR.

The total deficit for the entire service is given as nearly $75 million. It is important to recognize, however, that only $43 million of this total is chargeable to passengers themselves, including the sleeping and parlor car services. Another $9 million is attributable to the dining and buffet car. In a sense this is a direct corollary of the passenger service but it is well to note that it accounts for a substantial share of the total deficit.

Of great importance is the fact that the handling of property is a big cause of deficits. Thus, the express service is charged

Table VIII - 13

Canadian Pacific Railways

Passenger Deficit by Type of Service
1958

	Revenue	Out-of-Pocket Cost	Full Cost (including constant)	Full Deficit
		(millions of dollars)		
Total passenger service	63.3	106.0	138.1	74.8
Express	8.9	17.6	22.9	14.0
Other head-end service	5.8	10.6	13.8	7.9
Dining and buffet car	3.6	9.3	12.1	8.6
Sleeping and parlour car) Other passenger car)	41.4	64.7	84.3	42.8
News service and restaurants	3.5	3.9	5.0	1.5

<u>Ratio of cost to revenue</u>

	Out-of-Pocket Cost	Full Cost (including constant)
Total passenger service	1.67	2.18
Express	1.98	2.57
Other head-end service	1.83	2.38
Dining and buffet car	2.59	3.36
Sleeping and parlour car) Other passenger car)	1.56	2.07
News service and restaurants	1.11	1.43

with nearly $14 million and other head-end traffic, which will include mail, baggage and similar items, is chargeable with an additional $8 million of the deficit. In line with our earlier discussion, the ratios of cost to revenue for head-end services are higher than for passenger carriage.

As shown in Table VIII - 14, the CNR has roughly similar characteristics. Of the full passenger deficit of $180 million, the sleeping and parlor car and other passenger car functions accounted for $99 million in 1958, and the dining car function $13 million. As to express, however, the study on the CNR indicates a deficit of $38 million, compared with only $14 million on the CPR. Likewise, while the CPR had a deficit of $8 million on other head-end service, the CNR shows a deficit of $31 million. The costs of head-end service on the CNR are considerably more than <u>four</u> times the revenues.

Commuter Service

The foregoing are admittedly rough estimates of the sources of the passenger deficit. They do not have separate consideration of the special problems of the commuter service. Both roads have agreed commutation service is conducted at a loss. That this is so is certainly consistent with the experience in the U. S. On a full cost basis and as well as on out-of-pocket cost basis, commutation represents special burdens on the railroad industry. Our recent surveys from the U. S. Department of Commerce suggest that the commutation problem is one which must be faced by government at all levels because mass transit systems are essential to the

Table VIII - 14

Canadian National Railways

Passenger Deficit by Type of Service
1958

	Revenue	Out-of-Pocket Cost	Full Cost (including constant)	Full Deficit
		(millions of dollars)		
Total passenger service	66.1	168.4	246.4	180.2
Express	11.4	33.4	49.0	37.6
Other head-end service	8.7	26.9	39.4	30.8
Dining and buffet car	3.3	11.0	16.0	12.7
Sleeping and parlour car) Other passenger car)	42.7	96.9	141.8	99.1
News service and restaurants	.1	.1	.2	.1

Ratio of cost to revenue

	Out-of-Pocket Cost	Full Cost (including constant)
Total passenger service	2.55	3.73
Express	2.93	4.30
Other head-end service	3.09	4.53
Dining and buffet car	3.33	4.85
Sleeping and parlour car) Other passenger car)	2.27	3.32
News service and restaurants	1.0	2.00

health of our large industrial and metropolitan areas. The same principle applies to the Canadian economy. The question is then how maximum commutation service can be provided over rails and how such service shall be paid for. It seems essential that this decision be reached at government levels rather than being left entirely to the railroads.

Head-end Traffic

It is also important to note that the head-end service must be given special consideration. The hauling of passengers requires certain types of equipment and certain types of trains. There is not quite the same urgency about the handling of goods - whether express or mail. Their schedule needs are also different. The handling of these goods must compete in the market place with other forms of transportation. A hard, new look must be taken at the handling of property in passenger terminals. Perhaps the time has come for the integrated handling of all goods in that type of equipment and in that type of service which gives the best service at the lowest cost. Whether this represents passenger trains or freight trains or the handling of trailers in piggyback service or the entire substitution of trucks and busses for local train service cannot be decided in general terms. Different areas and different traffic volumes call for different solutions. It is clear that the future handling of goods must be considered strictly in terms of economic issues and not merely in terms of custom. There is more treatment of the LCL service in Chapter IX dealing with small shipments. As to mail service, it seems clear that railroads must attempt to achieve maximum revenue

from the handling of this traffic. If they cannot compete with other forms of transport under full compensatory rates, it may be necessary for the government to step in. If continued mail service by rail is essential for reasons of the postal service, some subsidy may be needed.

Conclusions on Passenger Deficits

The conventional view of railroad managements is that the passenger function is "incremental." Under this theory, managements argue that they need not charge depreciation or other "sunk costs." This is not based on solid accounting or economic theory. It is really an outgrowth of the belief that they cannot recover full costs from the service. This, in turn, is a judgment arising from the hard economic reality that raising fares to a mathematically indicated full cost level would not actually produce the necessary revenues. Thus, if fares were doubled, traffic volume undoubtedly would not be held even at present levels and therefore the deficit would become even greater. This appears to be the reason for the unwillingness of rail managements to calculate economically sound costs.

It must be recognized, however, that the burdens of cost exist whether a service can meet them or not. Thus, the cost calculation should be made first as a matter of information and policy guidance. Thereafter, general policy considerations may be brought to bear in determining what course of action should be followed.

It is clear that the passenger deficit can be eliminated only by virtual elimination of service. But even complete abandonment of

service would not wipe out the constant costs assigned. If the passengers and freight now moving in passenger trains cannot bear a share of fixed costs, government aid may be required if the balance of the traffic is not to take over the whole load. "Self-help" is certainly important as a method of reducing costs but we believe that no amount of "self-help" will eliminate the deficits.

Whether all or part of the service should be abandoned is closely linked to matters of national policy. Defense needs, problems of the mail service and the demands of commutation are among the issues to be faced and resolved.

It cannot be overemphasized that the full cost deficit of the passenger service is $180 million on the CNR and $75 million on the CPR. This represents 37 per cent and 19 per cent of freight revenues on the CNR and CPR, respectively. These figures make the issue one of national significance. Freight revenues as a whole must be made significantly greater than would otherwise be the case were it not for these deficits.

The burden of passenger service deficits on the railways and on the shippers of freight can be dramatized in yet another way. The railways have proposed as a criterion for a fair level of earnings a rate of return on net investment of 6-1/2 per cent after payment of income taxes. This translates into a rate of 10.38 per cent before income taxes for the CPR and a rate of 10.96 per cent for the CNR. These are the rates used to calculate the "cost of money" for handling grain. In 1958, the CPR railway net income was $57 million before income taxes. If the CPR

passenger revenues had been equal to the full cost of providing the service $75 million additional revenues would have been received, producing a net income before tax of $132 million, which represents a 9.43 per cent return on net investment in railway facilities, less than one percentage point short of the standard that CPR has chosen. This result has powerful implications respecting the freight service.

If the passenger service had earned 10.38 per cent, the total return would have averaged 9.43 per cent, which means that the freight service must have earned a return of over nine per cent before income taxes in 1958.

Of course, the CNR had a deficit of $10 million in 1958, and paid no income taxes. However, $180 million additional revenue would have produced a net of 6.09 per cent before taxes, implying that the 1958 freight service of the CNR actually yielded over five per cent return.

If it were generally appreciated that the CPR and CNR earned nine and five per cent return before taxes on their freight business in 1958, what would be considered the "most important factors causing the decline in the railways' financial position"? In view of its size, who can say what the drag on the railroad industry in Canada may have been as a result of the passenger service deficit? Who can assess what the railway capital structure and the railway technology would be today if the passenger service had been as profitable as the freight service over the years?

Clearly, the role of the passenger service is one of extreme importance to the whole railroad industry in Canada. If it is healthy, salutary results will flow through the entire railway system. If it is unhealthy, the entire railway system may be withering internally.

CHAPTER IX

SMALL SHIPMENTS

The Canadian railroads are not alone in facing special problems arising from the handling of small shipments. The number of such shipments generated by the modern industrial economy has been increasing due to many changes in marketing patterns, including the desire on the part of merchants to hold down inventories and the desire on the part of manufacturers to offer full lines of merchandise in a variety of styles, colors and the like. While the flexibility of truck service has weaned much of this traffic away from the railroads, the volume remaining is still substantial.

In 1958, the express services of the CPR collected revenues of $37 million from shippers. The corresponding figure for the CNR was $41 million. In addition, LCL traffic produces revenues of $17 million on the CPR and $30 million on the CNR. In the aggregate, the small shipments traffic accounts for $125 million worth of transportation on the two Canadian railways. Control over the net results of this activity is clearly a matter of major importance to the Canadian railways.

Express Traffic

The express phase has been partially reflected in the preceding chapter, where estimated deficits are shown (millions of dollars).

	Out-of-Pocket	Full
CPR	8.7	14.0
CNR	22.1	37.6
Total	30.8	51.6

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These figures represent the net burden of express traffic arising essentially from train operation. To some extent, these railway deficits may be offset by the net profits of the express companies which pick up and deliver the traffic. Reports to the Board of Transport Commissioners show the following results in 1958:

	Express Operations		
	Net Revenue	Expense	Income
	(thousands of dollars)		
CPR	27,129	26,972	157
CNR	30,683	30,223	460
Total	57,812	57,195	617

While there is a small net income from the non-railway phase of express service, the expenses do not include any allowance for a return on investment. We may, therefore, conclude that, in broad terms, the express burden amounts to $52 million on a full cost basis. If express traffic were paying a full share of its costs, the demands on other freight would be reduced by $52 million.

LCL Traffic

The typical small shipment via LCL weighs about 400 pounds and moves about 500 miles. It is picked up at an average cost of about 10 to 15 cents per hundred pounds. It costs the same amount to deliver. It must be handled at a freightshed at origin and again at destination. Frequently, it is transferred once or twice again at intermediate freightsheds. Each time, another 10 to 15 cents is added to the cost of each 100 pounds. Because of the nature of the traffic and the service it receives, it moves in lightly loaded cars, averaging only 4 or 5 tons. While it is the view of the railroads that no empty miles are chargeable to LCL, as a practical

matter some empties arise from what we may call "frictional unemployment" Hence, the subsequent estimates contemplate only a 10 per cent ratio of empty to loaded car-miles.

Table IX - 1 shows the components of the LCL cost on the CPR. With $17 million of revenue and $35 million of out-of-pocket cost, an out-of-pocket deficit of $18 million resulted. Adding in constant costs of $10 million brings the full cost deficit up to $28 million.

Table IX - 1

Canadian Pacific Railway
Components of LCL Freight Cost, 1958
(millions of dollars)

Total revenue	17.1
Out-of-Pocket Cost:	34.8
Gross ton-mile basis	1.0
Car-mile basis	3.7
Cars loaded basis	17.9
Car-day basis	.9
Yard locomotive-mile basis	5.1
Train-mile basis	3.3
Loss and damage	.5
Pickup and delivery	2.4
Constant Cost	10.5

Note: All costs (except loss and damage, and pickup and delivery) include pro rata share of LCL portion of cost of handling non-revenue freight ($1.6 million).

Thus, for every dollar of revenue received, the CPR incurs a burden of another $1.65 relative to the yardstick for the railroad as a whole. It is of interest to note that the constant cost would be raised to as much as $14 million if no provision were made for assigning some constant to passenger service.

It can be seen that the largest element of LCL cost is $18 million charged on the basis of cars loaded. This item, which alone exceeds the LCL revenue, is derived directly from the CPR regression model for station expense (Accounts 372, 373, and 376), and covers the platform handling at origin, transloading and destination points, and billing costs, which are a particularly large element in LCL service.

Substantially similar problems have existed on the CNR but the available records do not permit a calculation to be made. If the ratio of cost to revenue were the same as on the CPR, we would have out-of-pocket deficits of about $31 million on the Canadian National's LCL traffic. On a full cost basis, the CN deficit would be some $49 million.

Summary on Small Shipments

Based on the foregoing, we may estimate the total burden of Canada's express and LCL to be $80 million on an out-of-pocket basis and $129 million on the full cost yardstick. Stated differently, the full deficit measures the additional amounts which must be derived from other traffic sources if the CNR and CPR are to obtain the rate of return they seek overall. If a 6 per cent return is the goal, carload traffic must earn more than 6 per cent in order to offset the small shipments deficit.

As a matter of fact, if the CPR could have received its full costs for handling LCL freight in 1958, as well as the full costs of its passenger services, the resulting higher net income before tax would have been 11.44 per cent of net investment. Since this composite rate is higher than the target rate of 10.38 per cent assumed in costing passenger and

LCL traffic, it follows that in 1958, the carload freight traffic of the CPR, taken as a whole, earned more than the requested rate of return. The CNR system rate of return on a corresponding basis would be over 7-1/2 per cent before taxes (if the LCL cost revenue relationship of the CPR can be imputed to the CNR).

In recent months, internal management studies have been going forward on both the CNR and CPR which contemplate radical changes in the handling of LCL. The expectation is that economies will result, but no data have been released to permit a determination of the net deficits.

The small shipments problem undoubtedly will grow in Canada as it has in the United States. More and more emphasis will have to be placed on volume routing to maximize loads per car and to minimize the work of intermediate platform handling. Pressure will undoubtedly increase for the establishment of freight forwarder services and shipper associations to perform consolidation of shipments and to obtain the beneifts of carload rates. Truck competition may also be expected to siphon off more high rated traffic, although the impact on the railway company is minimized by its ownership of truck lines.

It seems inevitable, therefore, that consolidation of express and LCL services by rail will become necessary in the interests of economy and efficiency. Possibly a single small shipments agency may be needed to take over the routing of this traffic, using truck, rail or other services on the basis of cost and performance factors. Integrated truck

and rail service ("piggyback") may become a major factor in the handling of small shipments.

Without major changes in railroad practices, the probability is that the small shipments deficits will remain large.

CHAPTER X

COMPETITIVE RATES

Much of the Canadian railroad problem stems from the fact that revenue is lower than it otherwise might be. In a sense, this is a problem for all industries but it is an especially difficult one for Canada's railways.

Rates in the National Interest

A railway system is peculiarly affected with a national interest. Often the railway facilities are intended to open up new territory for development. This may be a conscious national policy, part of a plan to stimulate the economy. In addition to facilities, the railway rate structure can have great significance; it may be used to accelerate the growth of industry in the newly opened areas. Once a railroad is built, pressure develops and, indeed, long-run economic self-interest may require that rates be established at a "promotional" level. The railroad may thus become an instrument of national policy through its pricing mechanism.

A simple illustration of this in the U. S. is the fact that when there is a drought, railroads are asked to reduce their rates on hay 50 per cent in order to assist farmers and to prevent the destruction of livestock This is a rate reduction which most people in the United States accept as being sound, proper and desirable in the national interest. Yet it is not really clear just why railroads specifically should be asked to reduce their rates on hay and, indeed, why they should do it at all, except as a matter of public relations.

While railways generally are subject to national and regional pressures for special rates in order to permit economic development, the issue in Canada has been especially important. These pressures have arisen in part because of geography and economics. Canada is a large country with its population diffused and its natural resources localized. This requires extremely long hauls for many commodities from point of production to point of consumption. It is important to Canada's economy that such rates be kept as low as possible in order to permit a maximum flow of goods. The statutory grain rates were clearly a matter of national policy, permitting Canada to compete in the world grain trade.

The problem of distance is clearly seen in the treatment of the Maritime Provinces. Because these provinces are relatively far from their markets, a subsidy is paid to the shipper. The intent is to reduce his freight cost and in effect to "shrink" the effect of distance over which he must haul his product. By lowering the shipper's distribution cost in the Maritimes, the Canadian government enabled him better to compete with shippers in other areas.

The technique used is of no particular help to the railroad system. The cost of operating in light density areas, as we have seen, is much higher than in heavy density areas. The procedure used does not give a "bonus" to the railway for providing the service in a high cost territory or for providing relatively high cost service. Instead, the railway receives what is considered a "normal" rate and the shipper is given a reduction of 20 per cent or 30 per cent (depending on the haul) from this normal rate. As a minimum, this procedure needs careful review to determine just how the

normal rate is established and under what assumptions it may best be determined for purposes of the subsidy plan.

Similar issues apply with respect to other forms of government intervention in the determination of freight levels on special commodities to meet the needs of special areas.

Beyond this, however, there is a much wider area of traffic moving at depressed rates. This term is perhaps a "trigger" term and should be clarified at this point. There is no connotation of evil in our use of the term "depressed". Rather, the intent is to emphasize that there are many rates which are lower than "normal". Any rate which is below normal depresses revenues and ultimately has an effect on the net earnings of the railways. It remains to be determined hereinafter what some of the factors are which account for the depression of revenue.

Highway Competition

As we have seen in prior chapters government expenditures have been increasing rapidly in connection with the highway program. The effect has been to provide a new competitive system of road mileage - often parallel to the railroad mileage - for which traffic may be solicited. Railroad rates which were initially established with a view to the value of the commodity have had to be sharply reduced in order to retain traffic. Much traffic was entirely lost to the railways as a result of the highway program. Unquestionably some of this loss was due to the failure of the railways to meet competition early enough. However the economics of the situation cannot be denied. Government expenditures have provided the

facilities which have made it easier for trucks to compete with rails.

Table X - 1 shows the "indirect cost" to the public of the highway program for selected years since 1920. The highway program has been increasing and, further, the indirect cost itself has also been increasing. Despite some degree of price inflation in these figures, the net public contribution to the highway program has been an increasingly important factor which the railroad must face. In effect, every dollar of advantage given to highway transport puts pressure on a like dollar now received by the railways.

Table X - 1

Analysis of Canadian Government Expenditure on Highways
1928 - 1958

Year	(1) Expenditures 1/	(2) Revenues	(3) Indirect Costs (1 minus 2)
	(thousands of dollars)		
1928	68,702	31,377	37,375
1938	117,327	67,475	49,852
1948	306,379	175,618	130,761
1955	624,866	377,927	246,939
1956	783,316	422,849	360,467
1957	862,197	480,320	381,877
1958	937,059	504,469	432,590

1/ Sum of expenditures for construction, maintenance and administration.

Similar trends are suggested in the available data for government expenditures on air transport and waterways. The question now is first how have the railways reacted and second what alternatives exist for the future.

Competitive Rates and Agreed Charges

Table X - 2 shows the trend in traffic moving under competitive rates between 1951 and 1958 based on waybill study data adjusted to an approximate annual basis.

Since 1951 freight moving under competitive rates has doubled. In 1958 the Canadian lines handled 527 thousand carloads under these rates and derived revenues of some $123 million from the traffic. This represents 23 per cent of the total freight revenue from all-rail traffic between Canadian stations.

In addition to filing of competitive rates, the railroads adopted the system of agreed charges. Under this arrangement, rates are made by contract between a railway and a shipper at less than prevailing tariff rates, whereby the shipper agrees to ship by rail all or a specified proportion of his traffic on which the rates apply. This traffic aggregates some 291 thousand cars yielding revenues of $74 million.

Together the traffic defined as moving under "competitive rates" and "agreed charges" accounts for 37 per cent of the total intra-Canadian freight revnues.

The significance of these facts has been occasionally misunderstood. Undoubtedly, the rates at which this traffic moves are substantially below the normal level. If the existing volume could have been maintained at the normal level, revenues would have been considerably greater and the net earnings of the carriers correspondingly improved.

On the other hand, if the carriers derive some net revenue from the traffic, they may be better off to move it at low rates than not to move

Table X - 2

Comparison of Intra-Canada Traffic Moving Under Agreed Charges and Competitive Rates, 1951 vs. 1958

	1951 (times 76.5)	1958 (times 100)	Percent Change
Competitive Rates			
Carloads	259,029	527,000	103.5
Revenue 1/	$ 44,169,712	$ 122,932,900	178.3
Tons	10,935,912	20,135,040	84.1
Ton-Miles	3,011,244,714	5,948,591,700	97.5
Car-Miles	90,870,984	198,867,200	118.8
Agreed Charges			
Carloads	113,832	290,600	155.3
Revenue 1/	$ 11,128,339	$ 73,720,600	562.5
Tons	3,376,511	8,571,310	153.9
Ton-Miles	329,423,841	2,985,201,900	806.2
Car-Miles	11,398,118	120,270,600	955.2
Combined Competitive and Agreed Charges			
Carloads	372,861	817,600	119.3
Revenue 1/	$ 55,298,051	$ 196,653,500	255.6
Tons	14,312,423	28,706,350	100.6
Ton-Miles	3,340,668,555	8,933,793,600	167.4
Car-Miles	102,269,102	319,137,800	212.1
Averages			
Tons per car	38.4	35.1	- 8.6
Ton-Miles per ton	233	311	33.5
Revenue per car	$ 148	$ 241	62.8
Revenue per Car-Mile 1/	$ .541	$ .616	13.9

1/ The effect of the July 26, 1951 general rate increase upon revenues for the year 1951 has been understated. Therefore, the per cent change from 1951 to 1958 is overstated.

it at all. However, the level of rates at which it does move is not unaffected with the public interest. If some of the traffic moves at less than compensatory levels, net revenues are reduced, and other traffic is burdened with the deficiency. The principal criterion presently applied by the Board of Transport Commissioners with respect to the level of these rates appears to be compensativeness. An additional standard as a floor under depressed rates should be the competitive need, as measured by the net cost to the shipper via the alternate mode of transport having the lowest cost, including consideration of loading, unloading, warehousing, inventory, et cetera as well as the pure carriage costs.

Even beyond this, however, both the railways' and the shipping public's welfare require that depressed rates should maximize the net income of the companies. The railways' interest in this criterion is obvious. The public interest arises from the fact that the greater the net contribution above out-of-pocket cost that can be derived from these rates, the smaller is the burden of constant costs that remains to be borne by the less competitive traffic.

The freedom to make competitive rates and agreed charges offers the railway managements many opportunities to implement the inherent advantages of railway technology. In setting such rates, they should make full use of the principles of incentive loading, and of volume handling of traffic through which the low costs of modern railroading can be obtained along with a restored vigor and financial health of the railway industry.

An additional requirement of both regulatory and managerial importance is the periodic review of depressed rates established in the past to

assure that they continue to meet the criteria of compensativeness, competitive need, and maximum contribution in the light of current cost levels and technological circumstances.

At the same time, it is important to inquire into the nature of the competition. If the competitive pressures take the form of rates (or costs of private carriage) which do not reflect the true cost of providing the competing service, the economy of Canada becomes distorted. If the traffic is diverted, more total dollars will be spent on transportation as a whole than would otherwise be necessary. If the traffic is not diverted, some contribution to constant costs must be foregone, thereby burdening unnecessarily either the railways or other railway traffic.

When the railroads made their submission to the Turgeon Commission, they estimated that their revenues were some $50 million less than they would have been but for the reductions on competitive traffic. The current figure is undoubtedly greater merely because of the increase in traffic covered by such rates. Clearly, the matter is of sufficient magnitude as to warrant investigation of whether government policy may be contributing unfairly to these revenue losses.

CHAPTER XI

STATUTORY GRAIN

The railroad position is that traffic moving under the Crow's Nest Pass agreement is the only "inequity" in the railroad rate structure. To demonstrate this, two basic studies were undertaken - one of rates and one of costs.

In essence, the cost study shows that full costs including overheads, constants and a substantial return on investment are roughly double the present statutory grain rate level. This leads to the conclusion that the rates ought to be doubled or that a subsidy be provided which would produce the same net revenue to the railways as if the rates were doubled.

Simultaneously, it is argued that a normal rate on grain would also be double the present level. Thus, cost and rate analyses are both used to support the railroad proposal.

As to the rate comparison, the key assumption is that percentages of first class can be used as a yardstick to determine what a "normal" rate would be. However, since very little bulk traffic actually moves at class rates, this method is open to serious doubt. This is particularly true in the case of statutory grain where the shippers for many years have had little interest in debating with the railroads whether their traffic should have been rated 32 per cent or 25 per cent of the base scales.

As to the cost study, a number of technical problems are raised. These will be discussed later in Volume II. It may be observed here that

the proposed subsidy contemplates sufficient sums so as to make grain contribute 10.38 per cent return on investment before income taxes on the CPR, and 10.96 per cent on the CNR. Using the same basic technique as employed in the railroad study, we find that, in 1958 CPR traffic as a whole produced 4.1 per cent before taxes on net investment in railway facilities. Thus, grain is being asked to produce a profit factor about 2.5 times as great as the average traffic. As to CNR, of course, with losses on the traffic as a whole, the use of a 10.96 per cent profit yardstick for grain is even more remote from the actual average.

Many of the techniques in the grain study can be evaluated best in relation to their application to other traffic and other issues. Much of the cost charged to grain is not peculiar to grain but to the nature of the service. "Branchness" rather than "grainness" is at the core of many items of cost. Stated differently, the cost per ton-mile is just as high on a light density line in the East as it is in the West. Traffic using branches has high costs - not because of the commodity but because of the nature of the service.

A very substantial portion of the grain costs arises from branch line problems. A portion of this is described as "solely related" to grain and this category of traffic can be used to illustrate the principle.

Of $71 million assigned to grain in the CPR study, about $12 million arises from service on the solely related lines. These lines handle about 2.5 per cent of the revenue ton-miles of study traffic. If revenues were apportioned on the basis of mileage, we could say that this traffic contri-

buted about $1 million to the aggregate grain movement and the following tabulation would illuminate the situation:

	Solely Related	Other	Total
	(millions of dollars)		
Revenue	0.9	34.7	35.6
Cost	12.4	58.3	70.7
Deficit	11.5	23.6	35.1

Based on the foregoing, using the costs just as they are developed in the railroad study, nearly one-third of the calculated deficit is attributable to solely related branch lines. Substantial additional sums must be traceable to other branch lines.

A previous section of this appraisal has indicated some of the policy issues arising from the extension of branch lines. The data here indicate the great impact these policy issues have on the charges to grain.

The railroad analysis deals with costs as they were. No attempt is made to assess the operating costs as they might be, although cost of money is projected to a future or desired standard of earnings sought from the average segment of traffic. In making a final policy decision, the Commission may want to consider whether costs actually incurred are the sole test of a subsidy plan. This will be discussed in Volume II but it may be noted here that some of the actual costs are themselves the result of national policy decisions in prior years.

CHAPTER XII

CONCLUSIONS

This analysis points up the fact that the problems of the Canadian rail lines are:

1. partly inherent in railroading,
2. partly affected by past and present decisions involving national policy, and
3. partly subject to direct managerial control.

These features are all interrelated and interdependent to some degree. Solutions must take all three into account. These observations suggest the following lines of inquiry about which the Royal Commission on Transportation should have current facts and judgments.

The importance of branch lines in the cost structure must be weighed. Since the high costs of such lines are essentially owing to light density, a series of issues are raised on which the views of the railways and others are needed. Can traffic be added to existing lines? If not, can joint operation reduce the total costs of serving existing lines? What national standards can be devised for determining which lines should be preserved and which abandoned in the long run? What are the prospects for a substitute service which would reduce total costs? What safeguards are needed to protect the public which settled certain areas because particular rail lines existed?

Much of the total cost incurred by Canada's railroads today results from government decisions in prior years. Should these be reversed now or should the shippers and travelers be relieved of the burden of costs

arising from defense or other needs? If the government reimburses the railroads for costs incurred on national policy grounds, is the trucking industry adversely or unfairly affected? Is the economy as a whole helped or hindered?

Subsidies now exist in Canada. They arise from a variety of historical facts but the question today is whether they are still needed and whether the present form is appropriate. For example, there is a "bridge" subsidy on East-West traffic moving through the sparsely settled area east of Ft. William. The total authorized amount is $7 million - to offset the cost of providing this bridge between East and West. But, if we ask what the cost is, we may have a different concept of the magnitudes. The full cost of providing and maintaining the running tracks over the "bridge area" on the CPR alone is over $6 million annually. Substantial amounts are undoubtedly involved for this one item on the CNR.

At the same time, it should be recognized that some costs arise because railroad managements have consciously made certain decisions in the past. The competitive building of branch lines is illustrative. Who shall now bear the resulting costs? Is this the responsibility of the shipper located on such lines? If the cost of branch lines were to be subsidized by government, what safeguards or incentives could be devised to ensure that no more than necessary was actually spent? How much shall be left on the doorstep of present managements to solve as best they can?

Emphasis should not be confined to matters affecting costs. The revenue side of the problem is at least equally important. If the costs

of passenger service are reasonably low, and if passenger service is necessary, shall government provide the revenues needed? If railroad revenues from this or from competitive freight traffic are depressed because of "unfair" or "uneconomic" competition, what can be done to equalize the competition? Do trucks and passenger cars in Canada pay their way? Are waterways obtaining free a right-of-way which is paid for by the Government of Canada? Is sufficient revenue derived by the railroads from other assets or do the non-rail activities constitute a burden on the railroads?

The foregoing is not in any sense a complete list of the issues which the Royal Commission faces, but it indicates some ramifications which flow from the facts developed in this Volume. The Commission needs the assistance of the railways and the other parties affected in looking at the broad policy implications of the facts.

Some general conclusions on Canadian transportation from an outside observer may be of interest. Canada is a mixed economy in which investment decisions are made by both Government and private industry. One Government can weigh the total economic impact of such decisions. Thus Government deliberations on transport policy should be made in the light of total cost vs. total benefit for the country as a whole. This may call for a different organizational system within the Canadian Government so that there can be consciously comprehensive national policies on transport matters.

Canada has more railway capacity than it needs. This arises from the acts of prior managements and governments. But today's managements

and governments must decide whether the national interest is best served by a ruthless curtailment of rail facilities and services, by various forms of government assistance, by a re-assessment of other government programs, by insistence on railroad self-help in labor and material cost reduction, or by some combination of these steps.

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PRECIS OF EVIDENCE

Submitted to The

ROYAL COMMISSION ON RAILWAY TRANSPORTATION IN CANADA

on behalf of

The Following Grain Marketing Organizations

ALBERTA WHEAT POOL
MANITOBA POOL ELEVATORS
SASKATCHEWAN WHEAT POOL
UNITED GRAIN GROWERS

THE PROBLEMS OF THE CANADIAN RAILWAYS

VOLUME II

COSTING METHODS

W. B. Saunders & Co.
Transportation Consultants
Washington, D. C.

19461

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Scope of Report

This is the second of two volumes on the problems of the Canadian railways. Volume I dealt with the broad problems and policies of the railways, including the role of railroads in the Canadian economy, the nature of the revenues and the key elements which affect the cost of operation. The present volume deals with the cost techniques used by the Canadian lines in their submissions to the Commission. It is not organized in chapter form because the entire volume is merely an enlarged chapter from our original preliminary assessment submitted in May 1960.

The basic railroad presentation dealt essentially with grain moving under statutory rates, the so-called "Crows Nest Pass" rates. This analysis includes an elaborate cost study which was intended to demonstrate that existing statutory grain rates should be approximately doubled. The cost studies were conducted separately by the Canadian National and Canadian Pacific, although the basic techniques were essentially the same in theory. Stated differently, the two major railways made studies which differed in a number of details but which essentially used the same principles of cost analysis in developing the key unit costs and applying the unit costs to the study traffic.

Because of the general similarities in theory, and because this report will deal largely with the theory underlying the railway

presentations, our emphasis will be placed on the actual mechanics and specific figures of only one of the railways - the Canadian Pacific.

Railroad Costing Techniques in Canada

The grain study is an important contribution to the art of railroad cost finding. The study includes the new and important concept of regression analysis and rests on a number of special tests with the object of reflecting as closely as possible the characteristics of the traffic under consideration.

The Canadian cost study is in many respects a considerable advance over that of the average railroad in the United States. All too often the railroads have in the past relied upon general averages as applicable to particular traffic. In far too many cases assumptions have been made that the average amount of switching applies to particular traffic at origin and destination, that the traffic is handled in the average train with the average amount of intermediate handling, that special services are not identifiable for the particular traffic, that clerical costs are average, and so on. The assumption is also far too often made in the United States that the variable costs attributable to particular traffic can be determined by merely taking a flat percentage of total expenses and assigning such amounts as variable. These are important defects in the use of costs for rate-making in the United States. The approach of the Canadian Pacific and the Canadian National makes a real improvement.

On the other hand, it cannot be considered as producing "the answer." While great strides have been made in railroad cost finding techniques, with considerable credit accruing to the Canadian lines, it is our considered view that cost finding has not yet advanced to the state where we may consider the present results as gospel. Pioneering is certainly to be commended in this field and the Canadian lines are entitled to great respect for the work done to date.

To clarify these general observations it will be necessary for us to explore some basic cost issues.

Some Basic Cost Issues

For many decades it was commonly believed that cost finding in any meaningful way was impossible in the railroad industry. This view was held because of the obvious fact that most of the functions of the railway are performed not for any one commodity or any one movement but on a joint basis in which many different commodities moving between many different origins and destinations are handled together. This is most strikingly illustrated by the acceptance of the fact that a typical train which is the principal unit of service contains cars from many different origins with many different commodities moving to numerous destinations. Analysts threw up their hands at the idea of separating the costs so as to reflect the amount chargeable to any particular traffic.

Today we recognize that railroads are not unique. Other industries also have this problem of joint costs, although not to the same extent as in the case of railroads. The solution to the problem of joint costs requires some important assumptions and results in the use of various techniques of allocation or proration of expenses to traffic. This necessarily injects some lack of precision in the results but it does not mean that cost allocation is impractical.

Again using the train as illustrative, the procedures required for costing traffic recognize that the train or the train-mile is a unit of work, a unit of service. It must then be recognized that cost of handling any one car in that train may be a series of different amounts all depending on the question being asked. If we have a 50-car train consisting of different commodities and we are interested in the cost of one car, we can say that 1/50th of the total cost of running the train is chargeable on a pro rata basis to each car in the train. This is a clear and understandable result. However, if the question is asked, "How much cost was added to the total cost of handling the train merely by adding the particular car in question," we have a different issue and one which calls for more intensive analysis.

The answer to the question depends on a recognition of another concept - the difference between fixed and variable costs.

Rails are characterized not only by the existence of joint costs in which more than one item is handled concurrently, but also by a difference in the degree to which expenses and service units respond to changes in traffic volume. In its simplest form this can be readily visualized with reference to the president of the company. The railway will probably have a president whether traffic volume is increased or decreased 10 percent. If this is so, the president becomes a portion of the fixed cost. Changes in the volume of traffic will not change the dependence of the railway upon the president. On the other hand, we may visualize a particular area in which solid trains of iron ore will move from a mine to a mill. If we double the output of the mine, and if the existing trains are operating at full capacity, we will undoubtedly double the number of trains operated. In that event, it becomes clear that the train expenses are 100 percent variable with the traffic. This simple illustration is important because it points up the fact that some expenses may vary little or not at all with changes in the amount of traffic while other expenses may vary directly as the traffic volume changes.

In the particular illustration, with a solid train of a given commodity, we have assumed away a very important problem. The fact that additional trains are required is clear in the illustration, therefore we can accept readily the concept that all of the train costs for the added traffic are chargeable to that traffic. In the normal situation, however, traffic is not handled in solid trains in an isolated area and unrelated to other traffic. In the typical situation,

we are studying a particular commodity which is handled in a mixed train in an area where many different kinds of traffic are handled in many mixed trains. Furthermore, in the typical situation we do not assume away another important question - the degree of capacity utilized in the existing operation. In the normal problem, the plant is not used to full capacity. The locomotive does not always pull exactly what its maximum rating would call for. The yard crew does not switch all of the cars which possibly might be switched if it were operating with a full work load. The station clerks and attendants are not processing all of the waybills which they might handle if everything were operated in an ideal way. In short, considerably less than the full capacity of the plant and labor is utilized.

In such situations, and where we are concerned with only one or two cars in a mixed train, it is not so easy to see exactly what the variability issue is. If an engine is pulling a train with 50 cars and might just as well be handling 60 cars, the question which operating executives as well as rate makers must answer is what is the added cost or variable cost of handling an additional 2 cars of some specific commodity. The argument runs that the train is there in any case and that the wages will be incurred whether the traffic in question is added to the train or not. On this basis virtually no train cost other than a small amount of fuel will be assignable to the added car or cars.

The foregoing is a simplified description of what is known as the "added traffic theory." This is a perfectly valid theory in many cir-

cumstances. The difficulty with it is that it has no universal application. Under this theory one could go through each of the cars in a mixed train and ask in turn whether or not the train would run without any one of them. For each one, the answer would be the same - the train will run whether this car is included or not. It would follow then that all the cars in the train would have virtually no out-of-pocket cost. This is an important fact from the standpoint of the operating department but could be disastrous from the standpoint of the railway net revenue if the traffic department were allowed to make rates on this basis.

Long Run Variable Costs

This situation has led to another concept of variable costing. Consideration can be given to the extent to which costs are variable not in the short run but in the long run. Under this view, one does not start with the assumption that trains will be run just as they are run today. It is not assumed that any one car will change the entire railroad operation. Obviously this is not so. What does have to be recognized is that with a general change in traffic - not for any particular car - the railroad management may decide to change the total frequency of train operation. Thus a 10 percent change in the total volume of traffic may result in a change in the total number of train-miles operated. If the total train-miles were to go up 10 percent with a 10 percent volume of traffic, even though many of the trains might not be operating at capacity - in the sense that the engine could actually physically pull more cars - we would still find that on the

average and overall the train expenses were 100 percent variable with traffic.

On the other hand, a 10 percent change in traffic volume may result in an increase of only 8 percent in the number of train-miles offered. In that event, we would say that the train expenses were 80 percent variable with traffic volume. Under this circumstance, we would be impelled in the direction of treating only 80 percent of the average cost as applicable to any particular car. In the former case we would be impelled to treat 100 percent of the average cost as variable with any particular car.

(We make the comments in percentage terms merely to illustrate and not because out-of-pocket calculations must be expressed in percentages. Basically, out-of-pocket costs should be visualized as absolutes rather than percentages.)

It is the recognition of the important difference in the time period which leads to one of the major difficulties in railroad cost work. What is fixed from one day to the next may be variable from one year to the next. What is fixed from one year to the next may be variable from one decade to the next. In a sense, almost every kind of costing has some place in railroad cost analysis but we must always be careful to define the question for which an answer is needed. The wrong question can produce very good answers for a problem which is not being considered. No matter how good the answer is for some other purpose, it may be entirely wrong and inadequate for the purpose to which

it is applied. In general, variable costs developed for short run purposes will be much lower than costs developed for a long run problem.

There is no one answer to the question: "What is the out-of-pocket cost of this car?" Nonetheless we must make a decision in every problem as to the appropriate question and a meaningful solution. In doing so, we must always bear in mind that the further away we get from the direct and short run cost components and the more we get into the long range cost problem, the greater the uncertainty and the more we must rely on the prorate, the arbitrary factor, and general statistical techniques. When the analyst makes use of this concept, he must always recognize that he is dealing with many assumptions which are built into the very nature of the question he is asking. The assumptions are vastly multiplied over those required when the narrower question is asked: "What is the added cost of handling this traffic in addition to what I am now handling - from a short run point of view?" or in another form: "What will I save if I give up the handling of this present traffic - from a short run point of view?"

This development of the concept of the long run variable cost means that the total pool of expenditures has now been divided into two general categories: fixed and variable. The costs which are variable are treated as directly assignable to particular traffic. What is left is by definition not variable with particular traffic. It may be thought of as a fixed total pile of dollars not chargeable on any specific or actual basis to particular traffic. Yet the natural tendency is

to ask what are the full costs as well as what are the variable costs. Somehow there is often an expressed need to account for all of the money spent by the railroad. One is pressed to go beyond the simple statement that the cost of hauling commodity "X" from point "A" to point "B" is $300 per car plus a share of, for example, $200 million of fixed cost. Yet from the standpoint of the cost analyst, this is as far as one may go with meaningful calculations. Any step taken beyond this point must be recognized as essentially arbitrary.

The foregoing stems directly from the essential definitions and it must be thoroughly understood that any attempt to go beyond variable costs is necessarily the extension of the prorating concept rather than an actual "cost."

Essentially two methods have been found for making an arbitrary apportionment of these fixed or constant costs. One method is to treat the constant costs as being separable into two smaller parts - one part related to the length of haul and the other part treated as if it were related to terminal work. This is the method used by the Cost Section of the ICC in the United States. The separation between the line-haul and terminal items is in itself essentially arbitrary. Having developed these two smaller parts, the procedure is to divide each by an appropriate group of revenue units of traffic - revenue tons and revenue ton-miles. Under this system an average cost per ton and per ton-mile is calculated and then applied to any particular segment of the traffic. The effect is to prorate the constant costs on a ton and ton-mile basis of all traffic alike. This produces a so-called full cost. It is merely a statistical apportionment. It does not in itself

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determine anything about costs related to the particular traffic. Instead, it is the sum of the variable costs related to the traffic plus constant costs charged on a pro rata basis.

Another way of apportioning the constant costs is to treat them as a percentage additive. Under this system, the total pot of constant dollars may be related to the total pot of variable or out-of-pocket dollars. If the constant costs aggregate 30 per cent as much as the total out-of-pocket dollars, a 30 per cent factor will be added to the variable cost developed for a particular car of study traffic. In the illustration previously given, if the variable cost is $300 for commodity "x" from point "a" to point "b", and if the constant percentage factor is 30 per cent, the calculation will show a full cost of $390 per car.

This second method is really no less arbitrary than the first method. Both are essentially statistical exercises. The essential purpose is to account for all of the money spent in some uniform way.

In short, railroad cost finding has had to overcome numerous problems - first recognizing the inherent jointness of most of the costs and therefore conceding the need for some kind of pro rate in order to assign costs to particular segments of traffic, and secondly, developing the fact that among the joint costs there are some which are fixed regardless of work done and others which vary directly with traffic changes Among this last group it has been found too that some items vary in the short run but that most items will vary in the over-extended periods of time. The inherent nature of railroading is such that the longer the period of time being considered, the more difficult it is to arrive

at a pure and precise statement of "the costs" because of the basic difficulties previously described .

Costs for Management Purposes

We have pointed out that one of the great issues is whether the question to be asked deals with short run or long run considerations. While rate-making decisions generally are concerned with long run issues because rates are not made for short periods of time, costs can also play an extremely important part in management decisions. Thus, for example, management may want to know whether it is more economical to run many short trains or few long trains, whether to run trains fast or slow, whether to build large or small yards and in what combinations, etc. The ultimate test of the answer to these questions is the relative cost to the railway. Other things being equal that decision will be adopted which best serves the long run net revenue needs of the company.

Cost questions also come into play when a decision is needed on whether to adopt one or another kind of motive power or a new system of station operation or new accounting techniques or another innovation. When such questions are raised, the cost problem is one of comparing present results with prospective results. Typically the question revolves around a total cost yardstick in such matters but the specific form of the question should not bind us to the fact that the basic principles are the same as those previously outlined. There are still joint cost issues. There are still issues of the degree to which costs are fixed or variable. There are still issues as to whether the answers being sought deal with short run or long run considerations.

There is no reason why costs cannot be used for managerial control purposes just as much for rate-making.

If the techniques of the cost analyst are valid, they can be used in all kinds of management decisions - provided they are properly understood and evaluated. There is no reason why a system of costs cannot be used to answer a wide range of management problems entirely apart from rate-making. Thus, if a certain procedure is developed for determining the impact of traffic on track maintenance, the technique must be just as valid for management control purposes in determining future maintenance budgets and in determining how to apportion maintenance programs division by division as it is in determining what a minimum rate shall be under a system of agreed charges. If there is a technique for determining the amount of switching chargeable to particular traffic, the same technique ought to have interest and value to the operating department and to those assigned specifically to the duty of minimizing yard costs.

One of the greatest weaknesses in the railroad industry in North America is the failure of most companies to recognize this important fact. Cost techniques have no magic. They cannot be considered in a vacuum. If they are valid they should be able to stand the crucible of operations. The cost analyst should have the confidence of management at all levels and in all departments if he is to achieve his maximum value for the company and if, indeed, his techniques are to be considered entirely valid. The operating officers should understand cost techniques and know how to interpret the cost results just as much as the cost

technician must understand operations and be able to interpret cost data in terms of actual physical operations. In this critical sense, railroad costing is in its barest infancy. The need to control costs as a means of protecting net revenue is desperately urgent and the services of the cost analyst are needed at least as much in this field of cost control for management purposes as they are in the field of cost specially adapted to rate-making problems.

Actual vs. Standard Costs

The foregoing discusssion of use of costs at the management level leads to another basic issue in the field of cost analysis. The typical study starts with an accounting point of view. Money is spent accordingly to certain accounting definitions - a certain amount of money is assigned to a certain account which represents a certain type of expenditure. The cost analyst typically will start with this sum of money and apportion it over some group of "service units". That is to say the cost analyst will distribute the money actually spent over some measure of the work actually done. Typically, he makes some general assumption in order to simplify the work of apportioning the expenditures. For example, he may assign yard costs on the basis of cars handled. And yet not all cars require the same amount of handling.

The ultimate question is not whether the money was spent - the accounts show that it was spent. A more important question may be whether this was the right amount of money to spend in order to perform the function. Thus, we get back to the essential issues facing management and,

in a secondary sense, issues facing regulatory bodies. Granting that a certain sum was spent during a given year, the question still remains whether this sum is more or less than should have been spent. Was the function performed at maximum efficiency in view of the present known state of the art of railroading? How do these expenditures compare with what they would have been had the operation been conducted in accordance with some minimum standard of performance or productivity for the particular operation being studied?

We may think of this issue as one of comparing actual costs with standard costs. While it is in a sense a facet of the question previously raised about the use of costs in managerial purposes, it is an extremely important area for the cost analyst. In the ideal situation, the cost analyst would not only be aware of the total amounts spent and the work units against which they must be assigned but he would also know whether the amounts spent were more or less than could have been spent under another set of circumstances in order to accomplish the given amount of of work. For example, he might know that $30 million had been spent for a certain maintenance function and that 30 million gross ton-miles of freight were handled, resulting in an average of $1 per 1,000 gross ton-miles. He would also know that the 30 million gross ton-miles might have been handled with a maintenance cost of, for example, $20 million if certain steps had been taken to substitute either different equipment or different operating methods which would reduce the total cost. On the other hand, he might know equally that while $30 million was in fact spent,

the particular functions and particular demands of the territory were such that $40 million should have been spent in the handling of the 30 million gross ton-miles of traffic, with the result that a deferred maintenance allowance must be recognized as an obligation of the railroad to be met at some future time. This situation might very well arise in a case where the railway deferred maintenance in order to conserve cash; from a true cost point of view this is merely developing an accrued liability which one day must be paid off. Cost in the true economic sense may actually be incurred, in the sense that a liability is generated, even though actual cash expenditures may not be made. It likewise follows from this that the cost actually incurred may be well below the amount spent if in a particular year or in a particular territory cash expenditures are made which represent the result of accruing obligations really chargeable to traffic handled in prior years.

Cost Principles in Grain Studies

The studies made by CPR and CNR in pricing out the statutory grain rely on the principle of prorating the joint costs. They both depend on various techniques for separating fixed and variable costs. Some of the separations are statistical and rest on statistical assumptions. Others are more or less arbitrary and reflect merely general judgments about the degree of variability associated with particular expenditures. Both studies may be characterized as emphasizing long run variable costs. Both studies emphasize heavily the concept of costs for rate-making purposes without special consideration to the adaptability

of the cost techniques for general management purposes. Finally, both studies confine themselves strictly to expenditures made in 1958 or 1956-1958 and merely apportion these expenditures over the work done at that time. Neither makes any attempt to consider how these expenditures compare with any standard set of costs for the same volume of work actually done.

The detailed and exhaustive analyses submitted by the CPR and CNR range over many special studies and tests. But essentially the analyses are concerned with the search for suitable methods of prorating or assigning the system or divisional total costs to the particular traffic handled. This leads to some important basic conclusions.

Prorating the expenses as they were incurred in any given period tells us what was but does not indicate what might be. This does not make a study right or wrong. It does mean that costs which are abnormally high or abnormally low are both given equal consideration. Yet, for policy purposes, the user of the cost study may be more interested in the long run future results than in any particular "actual" results.

Likewise a prorating of actual expenses in a given period naturally reflects the volume and type of service offered at the time. This means a great many things. We can summarize by saying that the problems described in our Volume I are automatically built in to any cost calculation for a given commodity.

Some of these are at the very heart of the railroad system. Thus,

since many miles of track were built for reasons of national policy and since excess miles are in existence today, the costs of operating present trains over such miles are naturally reflected in the cost study. Likewise, the investment in and maintenance of such tracks is a factor in the costs of the traffic being studied. Without such tracks, the cost of present traffic volumes would be lower. Further, to the extent that light density lines exist because of a competitive building program, the present cost per unit of traffic is necessarily higher than it would be in a more rationalized system.

The effects of light density lines are particularly directed at grain in the case of the so-called "solely related" lines for which the railroad studies assigned to grain the very substantial sums representing the full cost of the entire lines. These lines are considered as "out-of-pocket" or variable entirely with grain traffic because it is alleged they would be abandoned if there were no grain. Since these are typically lines with light traffic, the effect is that very high unit costs are built into the study.

If a line was built to handle 10 million tons of freight and now handles only 1 million tons, it may be true that all of the investment is "chargeable" against present traffic because there is no other traffic to bear it. Yet, realistically we should also ask whether the line now has more capacity than is needed for present traffic. If so, is it fair and reasonable, from the standpoint of public policy, to charge the excess capacity to the customers still using the line? Do not the

burdens really belong on the customers who left the line or the government and railroad officials who built it or who keep more capacity than is needed for the remaining traffic?

To illustrate this latter point, we asked representatives to the grain trade to inquire into the circumstances of the various solely related facilities. We found that sections treated as wholly chargeable to grain were actually being curtailed while grain traffic is still moving. This illustrates the principle that the "solely related" concept actually charges present excess capacity to traffic. In this situation, today's "cost" is really a measure of yesterday's mistakes.

Again, railroad management has taken the position that it cannot recover its costs from passenger service because that service cannot bear the relevant costs if charged. Thus costs which normally would be assigned to passenger service are automatically kept in the freight column and charged against any freight traffic being studied. If the standard of track maintenance is high because of passenger service (and the railroad cost studies assume this), the cost of freight traffic is higher than it would be if there were no passenger trains at all.

Specific Criticism of Grain Studies

The intricately detailed grain cost studies of the railways are open to criticism at numerous points. A complete enumeration and discussion of the criticisms we feel are valid would be very lengthy. While in the aggregate they might add up to a substantial overstatement of grain costs, individually many of them would have only a minor impact. We have therefore elected to make rather a detailed evaluation of three or four aspects of their studies, as examples of the problems inherent in the costing of statutory grain, and of the shortcomings of the railways' treatment of these problems.

We have examined the track expense regression developed by the CPR as typifying the railways' use of the new technique of regression analysis. We find that CPR did not carry their analysis sufficiently far. There were refinements of the CPR data which would have improved the regression and contributed more detailed information. Examples of these are the breakdown of track miles into main line, branch line and switching components, and the separate use of yard and train locomotive switching miles. There was at least one highly relevant influence on track expense, namely, the extent of gradient and curvature, that they failed even to recognize and which would have contributed to the explanatory quality of the regression. The effect of the refinements plus the allowance for grades and curves could have increased the percentage of track expense variation explained from 83 percent to about 95 percent. Finally, the CPR should have studied the relative costs of freight and passenger service, or at least have assumed a much higher

influence of passenger gross ton-miles on track expenses, as being more realistic and providing a better unit cost.

We believe the defects in the regression studies stemmed from too much reliance on statistical results and technical tests applied to them, and not enough attention was paid to their economic and operating significance. Not only must regressions always be explainable in non-statistical terms, but the analyst must be sure that there are no important influences that he is omitting or refinements that he is glossing over.

We find that the critically important assumption made by the CPR that grain cars move in average trains is fallacious, and that the data adduced in support of this assumption actually proves that grain loads should have been charged with fewer train-miles and locomotive miles in the CPR study.

The CPR treatment of freight car-day costs has substantially overstated the amounts charged to grain, owing to inconsistencies between two special studies used in the estimates of car-days. As a result, certain car-days were twice counted in the grain movement, both as "active" days and as "idle" days added to the active days.

Lastly, the railways have included cost of money in the grain studies on a standard that conflicts with the one applied to operating expenses. The rate of return is based on the anticipated costs of raising new capital funds rather than the rate actually experienced,

but expenses are at actual 1958 or 1956-58 levels. Thus, the earnings standard looks far into the future while the expenses, and the investment to which this future rate is applied, reflect past and present operation, technology, efficiency, traffic volumes and excess capacity.

Detailed descriptions of these specific criticisms are provided in the concluding sections of this volume. As mentioned above, they were selected as illustrative of the deficiencies in the grain studies, and it should be understood that if no specific criticisms are here made of any other aspect of the studies that our "silence does not mean assent." We thought the Commission had rather be shown several well documented examples than a tedious compendium of unevaluable comments.

Conclusions on Costs

We have seen in the foregoing sections of this volume that the Canadian National and Canadian Pacific have made big strides in developing the art of railroad cost finding. Nevertheless, a number of criticisms have been levied against their basic approach. As was stated earlier, railroad cost finding is still in its infancy and while the Canadian studies are far ahead of others, this is still essentially the difference between the infant which crawls and the infant which sits.

We believe that the technical staffs of the Canadian lines are extremely competent and entirely worthy to bear the responsibility of advancing the frontiers of the art. We believe further that the

improvement that can be made in the techniques thus far developed by the Canadian lines will have great value to the economy of Canada not so much because of their use in rate-making but because of what they can and will eventually achieve as tools for management. Specifically we believe that the eventual goal should be a comprehensive system of cost controls, cost yardsticks and cost standards which will enable management better to plan cash expenditures and short range budgets, as well as long run investment programs, department by department, area by area and function by function. We believe that the development of such a system will enable managements to strive for maximum performance of the Canadian railway system at minimum costs with an effectiveness never before achieved.

Our basic analysis includes considerable critical study of the field of maintenance of way. We did not single out maintenance of way as having special defects or special burdens but rather because it has so many complexities that it illustrates well the principle we are seeking to establish. Our analysis makes clear that we need to know a great deal more about what causes track maintenance to vary - for example, the impact of freight vs. passenger service, the impact of grades vs. curves, the significance of different types of rail, different ties, ballast and the like. If the engineers and the cost analysts can be brought together so that each understands the purpose and function of the other, we believe that a whole new dimension can be added to the ability of management to control maintenance costs. At the same time,

this would enable much more meaningful results to be obtained for use in rate-making. To accomplish this desirable goal requires that top management support the basic principle that cost finding is needed at all levels and in all departments and that cost analysts and operating executives each need exposure to the other's background and experience. We should explain here that the term "operating" is not used in the narrow departmental sense but rather in the sense of the difference between line and staff functions. The cost analyst is a staff employee. He should be encouraged to work with line employees whether in the engineering department, equipment maintenance department, yards and terminals, terminal operation, accounting, or elsewhere in the company.

We believe that too many decisions in the railroad industry are based on general judgment without attempting to evaluate the many component parts of the problem in dollar terms. We believe that too many decisions are made on a departmental basis without regard to the ultimate dollar effect on the net revenue of the company as a whole. While this may sound critical of line officials, it is not so intended. It is entirely human that each department should tend to put its best foot forward as a matter of self-preservation. Unless a system is made available through which dollar magnitudes can be placed on the benefits to one department versus the losses to another department, it is most unlikely that the best possible answer can be achieved from the standpoint of the company as a whole. And we firmly believe that the best railway system for Canada from the standpoint of the national interest

will be the one in which the individual railroad companies are carrying the largest volume of traffic at the least possible cost, to their own greatest profitability as enterprises.

CRITIQUE OF CPR TRACK EXPENSE REGRESSION

An important tool used by the Railways in preparing their studies of the cost of statutory grain has been the technique of multiple regression. This technique, perhaps never before publicly used in such an extensive manner in costing traffic of individual railways, has great power, but must be used with great care and with considerable respect for its deficiencies and awareness of its limitations. In order to demonstrate the failure of the railways to use this tool to its fullest capacity, we wished to make a critical study of one of the major regressions used. For this purpose, we chose the track maintenance regression of the CPR, which assigns the expenses in accounts 202, 208, 212, 214, 216, 218, 229, 269, 271, 273, and 281, along with depreciation in account 266 for the corresponding subaccounts, to miles of track, gross-ton-miles, locomotive switching miles, and system constant.

The combination of accounts represents about $60 million or 13 percent of the total railway expenses of the CPR in 1958. Furthermore, the causal relationships between transportation service and track expenses are far from simple, direct, or well understood. For these reasons, this regression seemed well suited to illustrate both the problems of regression analysis and the possible inadequacies of the cost formulae of the railways.

In determining the efficacy and reliability of regressions, several tests are useful. The coefficient of multiple determination, "R^2", tells the percentage of the variation in the dependent variable, in this case track expenses, which is associated with and thereby "explained" by the variations in the independent variables, such as miles of track, gross ton-miles, etc. The higher the R^2 the better the fit of the regression with the data to be explained. The "Student t" ratios of the coefficients of the regression (to their own standard errors) indicate their significance. Unless the "t" ratio is at least approximately 2.0, the coefficient in question is ordinarily said to be not significantly different than zero, because there is more than a 5 percent probability that this particular coefficient could have arisen through pure chance, even though the true value in the universe were zero. In this case, one would not be justified in placing reliance on it. Also, the meaningfulness of a multiple regression requires that all the independent variables be truly unrelated to each other. If two or more of them in the same regression are substantially interrelated, the coefficients for the variables in question are unreliable. This condition, called intercorrelation, is disclosed by the simple coefficient of correlation between the variable becoming excessively high. This coefficient indicates the degree to which the variations in one are associated with the variations in the other. A coefficient of 1.00 would represent perfect intercorrelation. One or the other of the intercorrelated variables must then be omitted from the regression, or some way be found to combine them into a single independent variable.

The application of the above tests must be made with some flexibility and tempered with a comprehensive view. For example, one of the principal effects usually associated with intercorrelation is low "t" ratios for the variables intercorrelated. If these variables have adequately high "t" ratios despite appreciable intercorrelation, one probably would be justified in accepting the regression. Likewise, if a regression conformed well to external facts, and provided the best relationships possible to obtain for the desired variables with the data at hand, one should not reject it merely because the "t" ratios fell somewhat below the normal standard.

In addition to these technical statistical tests, a successful regression must also be modeled on variables and relationships among them which are logical, and the resulting coefficients should be consonant with known physical, technological, and economic facts. This is not to say that good regression analysis is confined to "statisticating" the accepted or the obvious, but only that the regression must be ultimately explainable in nonstatistical terms. While this last criterion should really "go without saying," only too often this is not the case.

The CPR track expense regression was as follows:

<u>Equation 1</u>

$$\underset{(.827)}{Y} = 1{,}208{,}000 + \underset{(6.1)}{1{,}137X_1} + \underset{(5.3)}{.165X_8} + \underset{(2.2)}{.391X_9}$$

Y = track expense accounts
X_1 = miles of track
X_8 = freight GTM plus twice passenger GTM
X_9 = locomotive switching miles

Note: All coefficients are expressed in dollars

The R^2 (shown under the Y term in parentheses) and the "t" ratios (similarly under their respective coefficients) are all adequate. No intercorrelation exists between independent variables (which will be the case hereafter, unless otherwise indicated). This regression, like all the other CPR regressions save one, was produced by relating three year totals of the period 1956-1958, indexed to wage and price levels of December 31, 1958, for thirty-one of the thirty-two divisions of the railway as it was then organized. The CPR study excluded their electric lines, which were the thirty-second division, as atypical. The constant item of $1,208 thousand was interpreted as a threshold, or non-size related constant for each division. Since all inputs were for three

years, it was divided by three for a single year constant per division, and multiplied by thirty-two divisions for a system total constant. No justification was advanced on behalf of the double weighting of passenger gross ton-miles relative to freight.

Thus we found that CPR had explained track expense as related to length of track (size of plant related), and running and switching usage of that track (output related). A recognition of a distinction between two classes of running usage had also been made, apparently in order to allow for the well-known fact that passenger train service causes proportionally larger track expenses than freight service. However, if passenger gross ton-miles really do have a different cost impact, could not the regression itself shed some light on the difference?

When freight and passenger gross ton-miles were introduced as separate variables in the regression, the results were:

Equation 2

$$\underset{(.845)}{Y} = 1{,}204{,}000 + \underset{(6.4)}{1{,}150X_1} + \underset{(0.5)}{.039X_6} + \underset{(2.4)}{1.105X_7} + \underset{(2.1)}{.363X_9}$$

Y = track expenses
X_1 = miles of track
X_6 = freight GTM
X_7 = passenger GTM
X_9 = locomotive switching miles

Some improvement in the overall fit occurs but the "t" ratio of freight gross ton-miles is quite low. The relationship between passenger gross ton-miles and freight gross ton-miles which we were interested in, while in the expected direction, is extremely unbalanced, and the simple correlation coefficient between them is seen to be also quite high: .90. This means that a division of railway having much freight traffic tends strongly also to have much passenger traffic. We are unprepared to accept the expression in its above form as a reliable indicator of passenger gross ton-mile cost relative to freight gross ton-mile. We do not propose necessarily to abandon the attempt to achieve a usable separation however. Whether the technique of combining freight and passenger with an equating factor of two was adopted by the CPR because of their lack of independence is not known. The device is a good one to meet the problem, provided that the relationship used to combine is satisfactory. We do not believe that a more adequate basis, perhaps a partly statistical one, cannot be found.

The locomotive switching mile variable (X_9) used by CPR also was a composite, in this case an unweighted one, of two different types of

switching, namely, yard switching and train switching, which could be expected to have quite different cost characteristics.

Equation 3

$$\underset{(.884)}{Y} = 917{,}000 + \underset{(5.1)}{878X_1} + \underset{(6.4)}{.166X_8} + \underset{(2.5)}{.377X_{10}} + \underset{(3.9)}{4{,}051X_{11}}$$

Y = track expenses
X_1 = miles of track
X_8 = freight GTM plus twice passenger GTM
X_{10} = yard loco switching miles
X_{11} = road loco switching miles

The relationship between road and yard switching cost, while extremely high, is again in the direction expected a priori. The fit is markedly better, and the "t" ratios are all adequate. Notice that this refinement has also lowered the constant term and the coefficient of track miles (X_1). The yard switching coefficient is only slightly lower than the coefficient for total switching (X_9) in equation 1, whereas the train switching has increased tenfold. This refinement seems to have great potential strength, but in its present form, the relationship is too extreme to be accepted without further substantiation.

Keeping the separation between yard and road loco switching miles, we added the remaining basic refinement in the CPR regression, that of breaking down the miles of track by type.

Equation 4

$$\underset{(.892)}{Y} = 800{,}000 + \underset{(1.7)}{1{,}194X_2} + \underset{(1.8)}{584X_3} + \underset{(1.3)}{2{,}586X_4} + \underset{(2.5)}{.125X_8} + \underset{(0.2)}{.061X_{10}} + \underset{(3.3)}{3.638X_{11}}$$

Y = track expense
X_2 = miles of running track, main lines
X_3 = miles of running track, branch lines
X_4 = miles of switching track
X_8 = freight GTM plus twice passenger GTM
X_{10} = yard switching miles
X_{11} = road loco switching miles

The separation of track miles into main, branch, and switching components has resulted in a minor further improvement in the goodness of it, as has each refinement we have introduced thus far. This indicates that all refinements have contributed to the "explanatory" power of the regression. The R^2 of this expression is a healthy 6-1/2 percentage points above that of equation 1. But the number of independent variables having doubled, three of the "t" ratios are showing signs of weakness, and an additional one is hopelessly low.

Let us look at the interrelationships among the coefficients and the changes that have occurred compared to earlier equations. Main track miles, at about the equation 1 level, are about twice the cost of branch track miles, which seems realistic. On the other hand, switching track miles are twice as costly as main running tracks, which is hard to accept. While gross ton-miles remain at a reasonable level, with adequate "t" ratio, the cost of yard switching traffic has declined to only one-sixth its level in equation three, and seems completely to lack statistical significance.

A comparison of equations 3 and 4 leads to the suspicion that the introduction of separate variables for both switching track and switching output, while it may have improved the balance of the expression, has not provided a usable basis for costing switching. The intercorrelation between switching tracks (X_4) and yard loco miles (X_{10}) is .59, significant but not high. Switching track cost per mile is patently too high, yard loco mile cost too low in relation to road loco switching mile cost, which is sixty times higher. While the switching output variable has been separated into probably quite different components, the switching track variable remains a combination of yard, way, and industrial tracks. If the cost per mile for yard tracks is actually higher than that for road switching tracks, then the use of a combined switching track variable, such as X_4, together with separate output variables, might well result in the coefficient for yard loco miles being depressed in order to compensate for the unduly high track mile cost, whereas the reverse would be true of the coefficient for road loco switching miles.

It is also important to call attention at this point to the extremely high (.88) intercorrelation between main track miles (X_2) and running output (X_8). This says that the more main track miles on a division the more running traffic it will have, which certainly makes sense. In this particular expression, the intercorrelation apparently has not had the debilitating effect that might have been expected, as only one of the two "t" ratios involved is below par, and that only a little. We shall have to be alert for trouble from this source in other expressions containing X_2 and X_8.

Introduction of main, branch, and switching track breakdowns of the miles of track showed promise of added strength, but apparently also raised several problems. Perhaps there is another way of approaching the refinement of the track mile variable. From working papers supplied by the CPR, we have developed estimates of the miles of roadway, miles of road switching tracks, and miles of yard switching tracks. Thus we have a basic separation of the size-of-plant variable into running and switching, and a further breakdown of switching into the two

dissimilar types that is parallel to the functional breakdowns we have in the output variable. 1/ The "Miles of roadway" variable was devised as a substitute for main and branch track miles, partly in response to the intercorrelation between main track miles and running traffic, and partly to see if the "roadway" concept produced better results than the "track" concept.

Equation 5

$$\underset{(.915)}{Y} = 887{,}000 + \underset{(6.6)}{.170}\, X_8 + \underset{(1.9)}{.837}\, X_{10} + \underset{(2.2)}{2.588}\, X_{11}$$

$$+ \underset{(1.8)}{655}\, X_{17} + \underset{(1.4)}{3{,}960}\, X_{18} - \underset{(-0.7)}{1{,}703}\, X_{19}$$

Y = track expense
X_8 = freight GTM plus twice passenger GTM
X_{10} = yard switching miles
X_{11} = road loco switching miles
X_{17} = miles of roadway
X_{18} = miles of road switching track
X_{19} = miles of yard switching track

The alternate size-of-plant variables produce a better fitting regression. The "t" ratios for the traffic variables are generally much stronger, and the three-to-one cost relationship between road and yard loco switching miles is well within reason. The roadway mile variable is reasonably related to the main and branch track variables in equation 4, and is about as strong. However, the switching track breakdown appears in a very poor light. Besides low "t" ratios, their relation is very extreme, the yard track mile coefficient being negative. We may have been only too successful in associating yard tracks with yard output, for the intercorrelation between X_{10} and X_{19} is .95.

1/ Unlike the previous refinements, which have been based on breakdowns of the CPR's own 1956-58 regression input data, these new data have not been used for this purpose by the CPR. Miles of roadway have been taken from the CPR working timetables for the end of the year 1959, and the switching track miles are for the year 1958. However, year-to-year changes in railway mileages are very small, and no significant non-comparability has been introduced. In fact, the sum of the two classes of switching track miles compare quite closely, usually within one or two miles on each division, with the variable X_4. The breakdown of switching track miles is not precisely parallel to the breakdown in loco switching miles. "Road switching tracks" are actually miles of track switched exclusively by road engines, and "Yard switching tracks" are miles of track switched by both yard and road engines.

We conclude that this approach has improved the overall fit and the output variables, but at the expense of the size variables, especially switching. In contrast to equation 4, the coefficient of yard loco miles may be unduly high in order to compensate for the negative track mile coefficient. Or viewed in another light, the output coefficients may be reasonable but the yard and road switching track coefficients may reflect large balancing errors.

It may be the case that the peculiarities exhibited by both equations 4 and 5, which have isolated the variables expressing the switching activities from those expressing running result from the attempt to fit linear models to essentially curvilinear cost functions. If the road and yard switching cost functions are markedly different, as common sense tells us is likely to be the case, and one or both of them are curved rather than straight, the multiple linear regression formula may respond by figuratively drawing chords across the curves at different levels of output. These would appear in the regression as contrasting pairs of extremely high and extremely low coefficients, such as we have found in equations 4 and 5.

We are satisfied that the use of separate switching variables improves the overall regression, and by drawing unto them the impact of switching on track expense, strengthens the quality of the coefficients of the running variables. We do not believe that they are yet an adequate basis for costing switching track expense, either in the rather elaborate forms above, for the reasons just discussed, or in simple, aggregative forms which merely conceal the unsatisfactory character of the individual parts by combining them. We urge that further research is necessary on that conglomerate of railway activities called switching to develop more accurate or reliable ways of relating track expenses to switching physical output and the facilities devoted to switching. This necessarily must be done by the railway staffs, or with their cooperation and assistance, so we are unable to procede any further at this point.

Whenever two variables are so highly intercorrelated that their separate coefficients are unreliable, one or the other of them may be eliminated from the expression. If they are truly substitutes for each other, one alone will produce as satisfactory results as using both. However, to the degree that each is known to have its own impact on the dependent variable, it must be remembered that the coefficient of the independent variable left in the regression will reflect their combined effect, and should not be interpreted as representing the impact of that variable alone. The single variable stands for both.

We have concluded that the existing data do not permit a meaningful separation of the impact of switching track miles and locomotive switching miles upon track expense. Therefore, we propose to drop the switching track variables from the expressions and allow the loco

switching mile variables to receive the entire cost variability of the switching functions. However, for the reason just mentioned, these coefficients cannot be interpreted as the variable cost of loco switching miles alone, and should not be used as such in costing traffic. These variables are in the regressions from this point forward merely to keep the coefficients of the running variables from reflecting switching costs. Pending further research, other methods must be found to assign track expenses to switching.

Equation 6

$$\underset{(.884)}{Y} = 1{,}026{,}000 + \underset{(2.5)}{1{,}580}\, X_2 + \underset{(4.4)}{911}\, X_3 + \underset{(2.5)}{.126}\, X_8 + \underset{(3.1)}{.498}\, X_{10} + \underset{(3.3)}{3.749}\, X_{11}$$

Y = track expenses
X_2 = main track miles
X_3 = branch track miles
X_8 = freight GTM plus twice passenger GTM
X_{10} = yard loco miles
X_{11} = road loco switching miles

This expression shows the effect on equation 4 of omitting switching track miles. The goodness of fit is only slightly less, all "t" ratios are adequate, and the relationships among the coefficients are reasonable, and conform to well-known facts.

Equation 7

$$\underset{(.905)}{Y} = 778{,}000 + \underset{(8.8)}{.191}\, X_8 + \underset{(4.1)}{.585}\, X_{10} + \underset{(4.1)}{3.830}\, X_{11} + \underset{(6.2)}{1092}\, X_{17}$$

Y = track expenses
X_8 = freight GTM plus twice passenger GTM
X_{10} = yard loco miles
X_{11} = road loco switching miles
X_{17} = miles of roadway

This equation is similarly comparable to equation 5. It, too, has only a little less good fit, very strong "t" ratios, and reasonable intervariable relationships. Equation 7 is a somewhat better fitting and stronger model than equation 6, but the latter contains valuable additional information from its main-branch separation, at very little loss of reliability. We are not prepared to choose between them at this point, but are certain that either represents a considerable advance over the CPR track expense regression (Equation 1) in terms of explanatory quality, and in the amount of significant and reliable information contained.

Thus far, our critical examination of the CPR track expense regression has shown the improvements that the CPR might have made had they tested their own data more fully in terms of further detailed breakdowns, and refined their analysis accordingly. However, there is another variable having an important effect on track expense which the CPR failed to develop any data on, and excluded altogether from its regression. This factor is terrain.

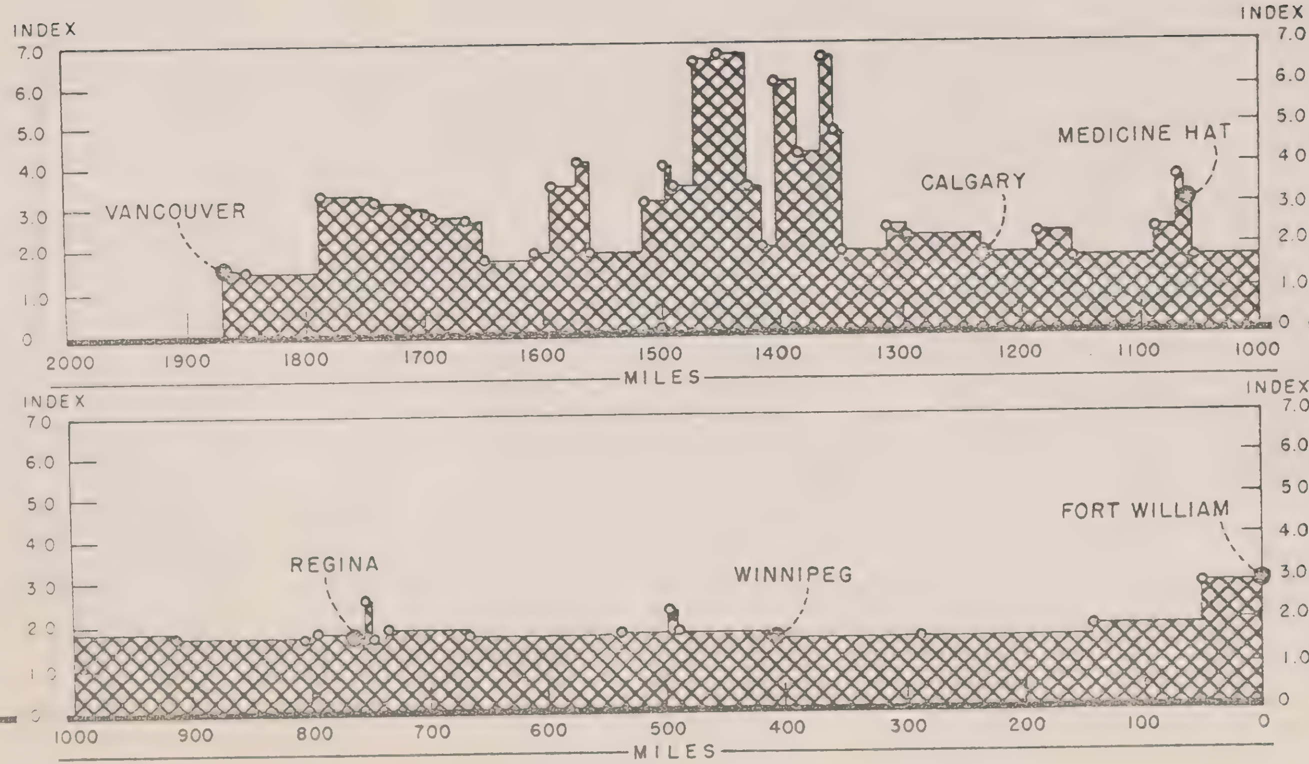
There are strong a priori reasons for believing that the costs of maintaining track in country which requires extensive grades and curves are higher than the costs where largely straight and level track is permitted. The main problem in introducing this factor into the track expense regression lies in developing a good statistical measure of the relative gradient and curvature situations on the different divisions of the railway.

We have found that the tonnage ratings applying to each section of road furnish the basis of such a measure. The tonnage rating of any given locomotive on different sections of the railway will vary inversely with the maximum adverse grade encountered. To a lesser extent, greater degrees of curvature will also cause lower tonnage ratings. Therefore, the reciprocal of the tonnage rating over each separate section of line was interpreted as an index of grades and curves for that section. For each section the lower rating in either direction for 1500 to 1800 horsepower diesel units was related to the estimated rating (5500 tons) for these units over level tangent track as a base. Wherever ratings for this class of unit were not given, the ratings for the class shown were converted to such a basis. To demonstrate the geographical distribution of grades and curves on lines which are important in the handling of statutory grain, we have prepared Chart 1 showing the indexes for the main line of the CPR from Vancouver eastward to the lakehead. This chart illustrates the non-random impact of grades and curves; but for costing purposes, it was necessary to produce average indexes for each of the 31 divisions of the CPR. To this end, the individual sections making up each division were combined using the road mileage of the section as weights. The four terminal divisions were assigned an index of 100. The composite indexes for each division are shown in the Appendix

When the track-mile data underlying the CPR regression were multiplied by the division indexes, a better fit was produced, with better "t" ratios for each variable.

19498

CHART I



CANADIAN PACIFIC RAILROAD

TREND OF GRADES AND CURVES BETWEEN FT. WILLIAM AND VANCOUVER

(INDEX BASED ON RELATIVE TONNAGE RATINGS)

CHART I

Equation 8

$$\underset{(.886)}{Y} = -289,000 + \underset{(8.4)}{601(X_1 \times X_{12})} + \underset{(7.2)}{.174X_8} + \underset{(4.8)}{.769X_9}$$

X =

Y = track expenses
X_1 = miles of track
X_8 = freight GTM plus twice passenger GTM
X_9 = loco switching-miles
X_{12} = index of grade and curve, road-mile weighted

This shows that with the indexes included, the regression explained more of the variation in track expense. Used in the above form, however, the indexes were assumed literally to measure the relative impact of grades and curves on track expense. In other words, an index of 200 (which it will be recalled indicated that a given diesel unit was rated at half the tonnage as it would have been on straight and level track) was interpreted as meaning that the track in question is twice as expensive mile per mile as straight, level track.

A less rigid assumption might have been that the indexes measure the relative impact of different increments of grade and curve. Under this theory there would be a uniform basic cost per mile of track, whatever its characteristics, and over and above this an additional cost per mile of track which would be proportional to grades and curves. The increments in the indexes above 100 will be indicative of the relative addition over straight and level track. To test this, the divisional indexes were each reduced by 100 points, then multiplied by the track-miles, and added to the regression as another separate variable, but not displacing simple track-miles (X_1). The regression itself determined that relativity of the grade and curve additive to the basic cost per mile of track which produced the best fit for the entire expression.

Equation 9

$$\underset{(.892)}{Y} = -144,000 + \underset{(4.6)}{794X_1} + \underset{(3.9)}{480X_1}(X_{12} - 100) + \underset{(6.6)}{.165X_8} + \underset{(4.3)}{.709X_9}$$

Y = track expenses
X_1 = miles of track
X_8 = freight GTM plus twice passenger GTM
X_9 = loco switching-miles
X_{12} = index of grade and curve, road-mile weighted

It will be seen that the regression indicates that each 100 point increment of grade and curve index above straight, level track at 100 has a cost impact per mile slightly more than half as great as the basic cost

per mile of straight, level track. Such track, having an index of 100, would be costed at $794 per mile. An index of 200, rather than doubling the cost, would produce $1,274. By using incremental indexes, we have permitted the effect of grade and curve to be given a much better weight relative to straight and level track expense. This has produced the above expression with a higher R^2, and with amply strong "t" ratios throughout, despite the appearance of some intercorrelation between X_1 and $X_1(Y_{12} - 100)$.

In addition to affecting the costs per mile of track, grades and curves also increase the costs associated with gross ton-miles. The method used above of applying incremental indexes to track-miles can also be used for gross ton-miles. However, the indexes applied to track-miles were averages of individual sections weighted by the road mileage of each section. It would be preferable for the indexes applied to gross ton-miles to reflect the weighting of each section by its own traffic level. Therefore a new average was developed for each division (also shown in the Appendix), in which the sections were weighted by their 1954 freight tonnage, expressed in net ton-miles, as disclosed by the 1954 CPR density study. This study was used in Chapter V, Volume I, of this report, and was described there. The increments in these traffic weighted division averages were multiplied by the gross ton-mile variable (X_8), and added to the previous regression model as an independent variable.

Equation 10

$$\underset{(.913)}{Y} = -194{,}000 + \underset{(5.6)}{1{,}014X_1} + \underset{(3.0)}{361X_1(X_{12} - 100)} + \underset{(1.7)}{.074X_8}$$

$$+ \underset{(2.5)}{.073X_8(X_{16} - 100)} + \underset{(4.4)}{.671X_9}$$

Y = track expenses
X_1 = miles of track
X_8 = freight GTM plus twice passenger GTM
X_9 = loco switching-miles
X_{12} = index of grade and curve, road-mile weighted
X_{16} = index of grade and curve, freight net ton-miles weighted

The addition of a grade and curve variable for traffic appears once again to have improved the overall fit. The R^2 shows that 91.3 per cent of the variation in track expenses can be explained by these relationships whereas the CPR regression accounted for only 82.7 per cent of the variation in expense. On the other hand, one of the "t" ratios has become marginally weak. Upon further investigation, it appears that the unindexed gross ton-mile variable (X_8) is strongly intercorrelated with the indexed gross ton-mile variable $(X_8)(X_{16} - 100)$. Their correlation coefficient is .83. If further use were to be made of this regression these two variables could be combined into one to eliminate the intercorrelation.

All of the foregoing tests of the effect of allowing for terrain have been confined to the original form of the regression used by the CPR. We have definitely established the value of this factor; let us now attempt to consolidate it with the improvements we were able to make in the CPR regression itself.

The improvements made in the original CPR regression were presented in two equations (6 and 7). Locomotive switching miles were separated into yard and road components; these switching variables are unaffected by the indexes of grade and curve. Miles of track were separated into main, branch and switching, and the switching tracks dropped. The mileage-weighted indexes used in the previous discussion were for each division as a whole. It was necessary to estimate separate indexes for the main and branch lines of each division. This was merely a matter of computing separate subtotals in each, after the individual sections of lines had been identified as either main or branch. The separate main and branch indexes are also shown in the Appendix. As might be expected, the grades and curves on branch lines are ordinarily less favorable than on main lines in the same territory. The effect of applying grade and curve indexes to equation 6 is shown in equation 11.

Equation 11

$$\underset{(.939)}{Y} = 39{,}000 + \underset{(0.5)}{527\,X_2} + \underset{(4.6)}{1178\,X_3} + \underset{(1.3)}{617\,X_2}(X_{14} - 100)$$

$$+ \underset{(0.8)}{172\,X_3}\,(X_{15} - 100) + \underset{(1.2)}{.104\,X_8} + \underset{(1.3)}{.056\,X_8}\,(X_{16} - 100)$$

$$+ \underset{(4.7)}{.758\,X_{10}} + \underset{(3.7)}{3.429\,X_{11}}$$

Y = track expense
X_2 = main track miles
X_3 = branch track miles
X_8 = freight GTM plus twice passenger GTM
X_{10} = yard miles
X_{11} = road loco switching miles
X_{14} = main line grade index
X_{15} = branch line grade index
X_{16} = freight traffic grade index

This is the best fit we have yet seen, 93.9 percent, over eleven points higher than equation 1. But, we have achieved it only by so proliferating the number of independent variables that only three of the eight have acceptable "t" ratios. And intercorrelation is present between seven pairs of variables. However, if the intervariable relationships appear reasonable, we would feel satisfied that they provide the basis for combining several of the weaker variables in order to raise the reliability of this expression.

A new relationship between main tracks and branch tracks has appeared here, in a sense the reverse of that obtaining in equation 6. The basic cost of a track mile of straight and level track appears to be twice as high on branch lines as on main lines, which is paradoxical. On the other hand, we see that the additive per mile for each 100 point increment of grade and curve index is over three times as high on main as on branch lines. A third important fact tieing these other two together, and not seen in the regression itself, is that the minimum level of main line grade index to be found in actual practise on the CPR is about 175, and most observations are 200 or over. This means in turn that the minimum total cost per mile of main track would work out at almost a thousand dollars, which is not nearly so far below the track mile cost of branch lines. This regression in fact rather implies that in terrain permitting easy gradients, the minimum costs for main and branch lines are very nearly the same, and as terrain becomes more difficult, the basic cost of main lines increases to higher levels than branch lines. The coefficients shown for simple main and branch track miles (X_2 and X_3) may be visualized as values which are reached when straight lines are projected to points which are well outside the range of conditions found in the actual data.

As suggested by this visualization, there is the possibility that these contrasting functions for main and branch lines actually may reflect a single curvilinear function underlying both, with the main and branch line observations ranging over different portions of the curve. More careful study of the economics of main and branch line construction and maintenance may be necessary in order to establish this.

With minor reservations, then, we are prepared to accept the reasonableness of the relationships shown in equation 11, at least pending further research. Therefore we have combined main track miles (X_2) with indexed main track miles (X_2) (X_{14} - 100) in the relationship between them disclosed by equation 11, namely, 617 ÷ 527 or 1.170. The new combined variable, X_{100} equals X_2 plus 1.170 (X_{12}) (X_{14} - 100). Similar combinations were made for branch line miles (X_3) and gross ton-miles (X_8) with their own indexed counterparts.

<u>Equation 12</u>

$$\underset{(.939)}{Y} = 40{,}000 + \underset{(4.0)}{527\ X_{100}} + \underset{(8.2)}{1{,}178\ X_{101}} + \underset{(6.3)}{.104\ X_{102}}$$

$$+ \underset{(6.1)}{.758\ X_{10}} + \underset{(4.3)}{3.429\ X_{11}}$$

Y = track expense
$X_{100} = X_2 + 1.170\ X_2\ (X_{14} - 100)$
$X_{101} = X_3 + .146\ X_3\ (X_{15} - 100)$
$X_{102} = X_8 + .539\ X_8\ (X_{16} - 100)$

X_2 = main track miles
X_3 = branch track miles
X_8 = freight GTM plus twice passenger GTM
X_{10} = yard loco miles
X_{11} = road loco switching miles
X_{14} = main line grade index
X_{15} = branch line grade index
X_{16} = freight traffic grade index

It will immediately be noted that this equation is identical with equation 11 in respect to its goodness of fit (R^2) and the ultimate coefficients of all the variables. However, the number of actual variables put into the formula has been reduced from eight to five, economizing on what the statistician calls "degrees of freedom," which, together with the elimination of the intercorrelation between the variables combined, has the direct result of raising all "t" ratios well above significant levels. Observe that even the ratios for the switching variables (X_{10} and X_{11}) have been raised, although they were in no way involved in the process of consolidation applied to the other variables.

Equation 13

$$\underset{(.945)}{Y} = -32{,}000 + \underset{(3.5)}{.119}\, X_8 + \underset{(2.8)}{.066}\, X_8 (X_{16} - 100)$$

$$+ \underset{(5.7)}{.769}\, X_{10} + \underset{(4.2)}{3.307}\, X_{11} + \underset{(2.7)}{809}\, X_{17}$$

$$+ \underset{(1.7)}{253}\, X_{17} (X_{12} - 100)$$

Y = track expense
X_8 = freight GTM plus twice passenger GTM
X_{10} = yard loco miles
X_{11} = road loco switching miles
X_{12} = roadway grade index
X_{16} = freight traffic grade index
X_{17} = miles of roadway

The application of the indexing principle to equation 7 has produced a regression with six independent variables, having the best fit yet achieved (nearly 12 percentage points above the CPR regression), and with only one "t" ratio below 2.0, and that by only a small amount! This regression, despite all the information that can be obtained from it, has enough strength to stand as it is, without combining any variables. We think this, together with equation 12, is progress indeed, and shows what the CPR could have achieved had they made fuller use of the data sources and research techniques available to them. We think they also show the possibilities for further progress in railway cost finding, and that, good as the railways' regression analyses might be, they are by no means the final answers.

Unfortunately, we have been unable to get further light on the question of the relative cost of freight and passenger gross ton-miles from this data. We are not in a position to develop more extensive data ourselves, or to initiate requisite special studies. Therefore our regression analyses thus far have reflected the acceptance of the CPR data. However, even in the absence of further empirical data, we feel that even now we can take a step in the right direction.

The CPR in its track expense regression assumed that each passenger gross ton-mile was equivalent in cost to two freight gross ton-miles, but gave no source for this relationship. Because of the high intercorrelation between passenger and freight gross ton miles, the multiple regression technique cannot be used to test this assumption or to derive the true ratio. (Actually, if passenger and freight gross ton-miles are introduced separately into any of the models we have discussed above, the relationship between them always appears considerably greater than two to one, which says that a higher ratio would produce a better fitting regression than the two-to-one ratio.)

There is ample basis in logic to support a much higher ratio for the CPR. The two-to-one ratio, it is believed, may have been a rough allowance for the actual wear-and-tear on track of passenger train versus freight trains. If wear-and-tear alone caused by the passage of gross ton-miles is proportional to the square of the speed of trains, an average passenger train speed of only 1.4 times the average freight train speed would produce a wear-and-tear ratio of two. But the higher cost impact of passenger train service on track expense is thought more largely to derive from the higher standards of track structure and maintenance that are required when a railway line is used by passenger trains. These higher standards include heavier weight of rail and superelevation on curves, better subgrade and ballast, and better and more frequent surfacing and alignment which are necessary because of the greater speed, comfort and safety requirements of passenger trains. It may be that the CPR factor of two was intended to allow for these higher passenger track standards. It is hard to see that this factor is large enough to cover both higher wear-and-tear and higher standards, but it might have covered either one alone. Let us adopt it for each for the sake of argument.

It seems self-evident that if a higher standard of structure and maintenance are established on a line because passenger trains must operate over it at passenger train speed, comfort and safety, then the freight trains that also use the tracks contribute to the wearing out and tearing down of that higher standard. The higher cost of the wear-and-tear of the freight trains on this passenger-standard line, in excess of what their cost would have been over a lower freight-only line, is clearly chargeable to the passenger service.

The CPR system in 1958 produced about six billion freight gross ton-miles and about one billion passenger gross ton-miles. Thus, if passenger gross ton-miles had had exactly the same cost as freight gross ton-miles, passenger trains would have accounted for one billion

out of a total of seven billion freight equivalent gross ton-miles. But with passenger gross ton-miles having a wear-and-tear equivalent of two freight gross ton-miles, the passenger service would have been chargeable with two billion out of a total of eight billion freight equivalent gross ton-miles, if all lines had been maintained to freight-only standards.

Actually, virtually all the passenger gross ton-miles and part of the freight gross ton-miles took place over lines maintained to passenger standards, which can be assumed to double the cost. Supposing that at least one-third of the freight gross ton-miles were on passenger lines, then four of the above eight billion total really represented eight billion freight equivalent gross ton-miles on passenger-standard lines, which, together with the remaining four billion gross ton-miles on freight-only lines, brings the total to twelve billion freight equivalent gross ton-miles. Of course, the actual six billion freight gross ton-miles can only be charged with six of these twelve billion. As a result, we can conclude that under these assumptions, the one billion actual passenger gross ton-miles on the CPR in 1958 were equivalent to six billion freight gross ton-miles. Thus it appears that a ratio of six-to-one would more nearly reflect the freight equivalence of passenger gross ton-miles than the ratio of two-to-one used by the CPR. If the fraction of gross ton-miles taking place over passenger lines is actually one-half or two-thirds, the ratio would increase to seven- or eight-to-one.

When the six-to-one ratio was applied to the passenger gross ton-miles used in the previous regressions, and added to the freight gross ton-miles, the new running traffic variable was substituted in equations 11, 12, and 13.

Equation 14

$$\underset{(.943)}{Y} = 86{,}000 + \underset{(4.3)}{609\, X_{103}} + \underset{(8.7)}{1{,}201\, X_{104}} + \underset{(6.4)}{.067\, X_{105}} + \underset{(6.2)}{.741\, X_{10}} + \underset{(4.2)}{3.212 X_{11}}$$

Y = track expenses
X_{103} = $X_2 + .983\, X_2\, (X_{14} - 100)$
X_{104} = $X_3 + .135\, X_3\, (X_{15} - 100)$
X_{105} = $X_{80} + .557\, X_{80}\, (X_{16} - 100)$
X_2 = main track miles
X_3 = branch track miles
X_{10} = yard loco miles
X_{11} = road loco switching miles
X_{80} = freight GTM plus six times passenger GTM

This equation results from substituting the new running traffic variable in equation 11 and then combining the variables in relation to their coefficients in that equation, in the same manner as was used in equation 12. The new expression is generally similar to equation 12 (except for the coefficient of the substituted variable), has a better fit, and amply strong "t" ratios despite a coefficient of correlation of .80 between the main track and the running traffic variables (X_{103} and X_{105}).

Equation 15

$$\underset{(.945)}{Y} = 68{,}000 + \underset{(3.5)}{.079}\, X_{80} + \underset{(2.8)}{.044}\, X_{80}\,(X_{16} - 100) + \underset{(5.4)}{.741}\, X_{10}$$

$$+ \underset{(3.9)}{3.135}\, X_{11} + \underset{(3.0)}{864}\, X_{17} + \underset{(1.5)}{229}\, X_{17}\,(X_{12} - 100)$$

Y = track expenses
X_{80} = freight GTM plus six times passenger GTM
X_{10} = yard loco miles
X_{11} = road loco switching miles
X_{12} = roadway grade index
X_{16} = freight traffic grade index
X_{17} = miles of roadway

This expression, corresponding to equation 13, remains at the "highwater mark" for goodness-of-fit which was established by that equation. Some "t" ratios are slightly up, some slightly down, some unchanged. The only one under 2.0 still is high enough to warrant acceptance of the regression.

Drawing to a close our critical study of the CPR track expense regression, let us assess what we have accomplished. Without any suggestion that these represent the ultimate contribution to track costing, or that they have exhausted the possibilities of the refinements we have introduced, we present equations 14 and 15 as indicative of the improvements that can and should be made. Much more research, data collection, and testing, engineering measurement technique development, study, etc., are needed on the cost impact of switching, freight traffic vs. passenger traffic, grades and curves, depreciation costs vs. cash expenses, and many other features of roadway maintenance before we should be satisfied with any track cost function. Similar statements can be made about most other elements of railway cost.

However, so far as they go they are improvements over the CPR regression. We have presented them both, because we feel that each seems to have something the other lacks, and at the same time, they substantiate each other.

CPR USE OF AVERAGE TRAIN WEIGHTS

The CPR, in estimating the number of train miles and locomotive miles incurred by grain, in essence divided the gross ton-miles of grain handled on each train run by the average weight of the trains on that run. The calculation was made separately for traffic in each direction, using train average weights so separated. Gross ton-miles of loaded grain cars and those of the imputed empty movements were also treated separately, the loaded gross ton-miles being divided by the average weight of local trains or of through trains, depending on whether the grain originated on the train run or was "overhead," and the gross ton-miles of empty cars being divided by the weight of the average train, local and through combined. An adjustment factor was introduced to reflect the resistance characteristics of heavily loaded traffic. This had the effect of decreasing constructive train miles for grain loads and increasing them for empties. It can be seen that the CPR has taken the position that the statutory grain traffic cannot be either credited with moving in heavier than average trains or charged with moving in lighter than average trains.

There is a widespread opinion in Western Canada that grain is economical traffic for the railways because, among other things, it moves in heavier than average trains. This is thought to be a result of the two facts that it loads very heavily per car and that it may be handled in large blocks or volume movements, and is therefore susceptible of moving in "solid trains," which could be very long and heavy. Perhaps to test this opinion, Commissioner Balch requested the CPR to determine the degree to which grain traffic was handled in solid trains from Winnipeg to Fort William. Grain traffic is most heavy between these two points on the CPR, and it is here that the maximum potential for solid trains would occur.

In response to this request, CPR introduced Exhibit No. 142, which was intended to diminish credence in their ability to handle grain in solid trains. All symbol and extra trains moving eastward during three sample periods in 1959, adding up to 23 days, were analyzed. Only 13 trains, or 10.3 percent out of the 126 train total were shown to "contain grain loads only." If only 10 percent of the trains were solid grain in the territory where grain traffic was heaviest, must not the CPR assumption that grain moves in average trains be a reasonable one?

At our request, the CPR furnished a list of all 126 trains underlying Exhibit 142, giving for each the number of grain loads, other loads, and empties, and the trailing gross tons and net tons. Upon examination we were unable to verify the classification of trains found in Exhibit 142. The list of individual trains did not identify them as to which of the three sample periods they fell into, or whether they were symbol or extra trains, but in total, showed the following:

1. One train had been deleted on account of an obvious error in tare weight, leaving 125 trains in the sample.

2. No trains literally "contained grain loads only," as all contained at least one empty car.

3. Three trains consisted of one empty car each, one train consisted of one grain load and three empties, another of one grain load and six empties, still another of one grain load, two other loads, and eight empties. We submit that these six trains of from one to eleven cars each, only one of which contained more than one loaded car, cannot possibly have operated through from Winnipeg to Fort William unless they represented some extraneous condition, such as the return of power, or the picking up of stray bad-order cars, etc. We believe they should be excluded from the study.

4. The remaining 119 trains averaged 4,126 gross tons of trailing weight. Twenty trains, or 17 percent, contained no loaded cars other than grain.

5. Eleven other trains contained fewer than six non-grain loads each and may be called preponderantly grain trains.

6. The 31 (26 percent) solid or preponderantly grain trains had an average trailing weight of 5,661 actual gross tons.

7. Forty-seven trains (40 percent) contained fewer than six grain loads each. These preponderantly or wholly non-grain trains had an average weight of 3,376 tons.

8. Only forty-one trains (34 percent) conform to the substantially mixed character assumed by the CPR. The average weight was 3,827 tons.

We conclude that Exhibit 142 failed fully to disclose the number or percentage importance of "solid" grain trains, as it purported to do; that a narrow construction of the term "solid" gives an inadequate measure of the extent to which volume handling of grain has been achieved by the CPR; that preponderantly grain trains do have an average load considerably in excess of non-grain trains; and that therefore the train handling the average grain car over this line must be a heavier-than-average train.

In an effort more precisely to establish this principle, we analyzed each of the 119 individual trains. Since the CPR had included an adjustment to reflect the train resistance of heavily loaded cars, this adjustment was performed on each of the trains, using the basis applicable to Winnipeg-Fort William. The trailing weight of the trains

was thereby expressed in equivalent gross tons (EGT), the unit used to construct grain study train miles. The equivalent gross tons in each train attributable to grain were estimated according to one of the following rules:

1. Trains containing fewer than 6 non-grain loads: tare weight of empty cars taken at 30 equivalent gross tons (23 actual tons); non-grain loads taken at 60 equivalent gross tons (23 actual tons tare, 35 actual tons load); balance of train equivalent gross tons taken as grain.

2. Trains containing six or more non-grain loads: grain taken at 79 equivalent gross tons per car (23 actual tons tare, 58 actual tons load); balance of train equivalent gross tons taken as non-grain and empty.

Using these rules, the percentage of each of the 119 trains assignable to grain was calculated. The sum total of the fractions assigned to grain, aggregated for all trains, represented the constructive trains assignable to grain. Similarly, the aggregate of the remaining fractions of trains were the constructive trains for non-grain traffic. The total constructive trains of either class of traffic for any grouping of trains could be related to the total equivalent gross tons for that class to derive the actual average train weight.

The average weight of all trains in the study was 4,302 equivalent gross tons. This is the equivalent of the train weight that CPR imputed to eastbound grain loads on this train run in 1958. The total weight of non-grain traffic, including empty cars, was 274 thousand equivalent gross tons. On a prorata basis, train for train, this traffic was assigned 73.4 trains, which produces an average weight of 3,733 equivalent gross tons, or 13 percent less than the average. In contrast, the 238 thousand equivalent gross tons of grain, accounting for the remaining 45.6 trains, averaged 5,219 equivalent gross tons per train, 21 percent more than the average. This is the train tonnage properly assignable to grain on this train run, and suggests that, if the study period is representative of 1958, the CPR overstated eastbound train miles by 21 percent. It should be noted that the Kenora division, of which the portion from Winnipeg to Fort William is overwhelmingly the most important part, accounted for 33 percent of the total grain study gross ton-miles.

The above study exposes the fallacy of the assumption that because many, if not most, trains carry some grain, an average train weight is proper. It showed that 89 of the 119 trains carried some grain. For 47, grain made up less than half of their consist. These

trains averaged 3,684 equivalent gross tons. The other 42 trains had more than 50 per cent grain, and averaged 5,406 equivalent gross tons. The higher the proportion of grain, the heavier the train, seems to be a good generalization. The latter group of trains, in fact, while fewer than half the total trains, carried 85 per cent of the grain!

The cost consequences of this error are substantial. They affect all train and locomotive costs in the study, including cost of money as well as operating expenses.

CPR TREATMENT OF CAR-DAY COSTS FOR BOX CARS

In the original study of the cost of statutory grain, the CPR divided the maintenance cost of freight cars between a so-called "mileage portion" and a "time portion," based on a 70-30 split used by the U.S. I.C.C. in its Rail Form A. The "time portion" aggregate was then divided by the total number of "active" car-days experienced by freight cars on their lines in 1958, which had been developed according to the procedures followed under Rail Form A. These procedures count as active all car-days moving in trains plus certain standard active day allowances for each type of intermediate or terminal switching move. Any storage, repair or delay enroute time in excess of the standard allowances are considered "idle" days and excluded from the car-day computation.

To apply the cost per active car-day to the grain study, the average cycle of active car-days experienced by grain traffic between origins and export positions was determined on a sample basis. A sample was drawn of some 3,700 movements, which were then traced through the car service records from the first empty movement following the previous unload to the one following the grain unload. Empty car-days east of the lakehead were excluded from the study. All other empty car-days in which the car did not move were eliminated as idle, except for the period immediately preceding and following the movement of the grain load. Also eliminated were empty days enroute in excess of what CPR considered to be "normal performance" between certain major terminals. If no empty movement preceded or followed the grain movement, cycles were begun on date of waybilling of grain at origin, and ended on date of grain arrival at export position. The sample cycles were expanded to cover the total movement of CPR grain.

A specimen of the worksheet form used in tracing one grain movement is shown as Exhibit A. This car arrived under load at Fort William on July 8, and began its grain cycle by departing empty on July 13. Passing through Moose Jaw, where one day, July 18, was eliminated as idle, it arrived at Tugaske, Saskatchewan, on July 19. On July 26, a waybill was issued, and five days later, July 31, the car departed via Eyebrow and Moose Jaw. Arriving at Fort William on August 5, it departed empty once more on August 9, completing a grain cycle of twenty-seven days, less one idle day at Moose Jaw, or twenty-six active days.

If the definition of active days were consistent as between the Rail Form A system total and the grain cycle study, the unit cost and the aggregate units to which it was applied were comparable. The CPR method had the effect of prorating the cost of "idle" days over all active days, so that movements requiring more than average active days received more of the cost of idle days than movements requiring fewer than average active days.

EXHIBIT A

C.S. 23

CANADIAN PACIFIC RAILWAY COMPANY. TRANSPORTATION DEPARTMENT

.........19.......

Mr 6489

OK

Dear Sir: Claim No. ....

Referring to your communication of ....19...... the following are the movements of CP Car No... from TUGASKE SASK. to 5002 with JULY 26

MOVEMENT	DATE Month	Day	Year	TIME		TRAIN	CONDUCTOR
Received from.......Ry.							
Arrived 5002	7	08				L	
Left m/-	7	13				E	
Arrived 6300	7	17				"	870
Left "	7	19				"	
Arrived 6489	7	19				"	
Left "	7	31				L	
Arrived 6488	7	31				"	
Left "	8	01				"	870
Arrived 6300	8	01				"	
Left " m/L	8	02				"	
Arrived 5002	8	05				"	
Left " m/L	8	09				E	419
Arrived 5200	8	10				"	
Left	8	14				L	
Arrived							
Left							
Arrived							
Left							
Delivered to.......Ry.							

NOTE.—Time in Transit.........Days.........Hrs.........Mins.

Yours truly,

2059

In Exhibit 132, the CPR introduced certain corrections and modifications of its original cost study. Among the latter was an apparent shift in the method of car-day cost. The "time portion" was now divided by total car-days of CPR cars, whether on or off-line, producing a lower cost per day. In order to apply this to grain, it was necessary to develop a total car-day aggregate in lieu of the active car-days previously used. For reasons not explained, the most obvious method, that of reworking the original active day cycle sample to include the idle days, and supplementing this with additives for back shop repair days, was not followed. Instead, a 300 car subsample of the active day cycle sample was drawn, and the car service records of these cars traced for the entire year 1958. Supposedly following the same rules for distinguishing active from idle days, the number of idle days during this year for the subsample was produced. Account was also kept of the number of days these cars were off the lines of the CPR. The remaining calendar days were then assumed to be active on-line car days. After charging a nominal allowance of idle days to off-line time, the ratio of the remaining idle days to the on-line active days was calculated at .5814. Therefore, the total active car-days originally determined for grain were increased by 58 percent, and the cost per total car-day applied. Once again, if the definitions followed in the grain cycle and idle day studies had been consistent, unit costs and aggregate units would still have been comparable. But the modification itself is more a matter of form than of substance, because, as before, the method assigns idle car-day cost in proportion to active days, producing higher than average amounts to moves requiring more active days.

The CPR method was based on the theory that idle days are a necessary adjunct of active days, but that, unlike the active days, which can be directly assigned to particular loaded or empty car movements, idle car-days are a kind of overhead cost, and can only be prorated or apportioned in some general way. The CPR chose to prorate them over the active days, a theory which we shall criticize in a later part of this section. But even further, the CPR contends that the active days of their cars while on their lines should bear a disproportionately large share of the idle days relative to the active days off their lines.

The origin of this distinction and the justification for it advanced by the CPR is that the per diem car-hire rate which the CPR receives when its cars are off-line "allows for approximately 10 percent days of non-utilization (surplus or bad-order)." Consequently, the CPR applied an idle-active ratio of .1111 (10 divided by 90) to off-line days. Inasmuch as their average idle-active ratio, as developed by their 300 car subsample, was .4397, the idle-active ratio applied to on-line active days, which was derived by residual, was very much higher (.5814). In other words, since the CPR has assumed that the

so-called allowance built into the per-diem rate is the maximum that is chargeable to off-line active days, it follows that "the only place the CPR can recover the cost of the [remaining] idle days is from the CPR on-line active days."

We submit that this extreme distinction between off-line and on-line days in respect to the assignment of idle time is improper, and that the source and justification for the lower ratio for off-line days is irrelevant. Off-line days are not substantially distinguishable from active days on-line in respect to back shop time, bad-order time or storage time. Therefore, if idle days are genuinely an overhead, not chargeable to any particular movement, idle days can no more be assigned in a non-average way to active days in an off-line movement than they can to any particular on-line movement. The fact that the per diem arrangement may have built in the idle experience of the average U. S. railroad, and whether or not this allowance is adequate for any particular railroad participating in the arrangement, has nothing whatever to do with the actual idle-experience of CPR box cars, which is incurred in consequence of the use of CPR cars wherever they may be. If the per diem amount, or the idle day allowance supposedly built into it, is inadequate for the CPR, this is another argument, not relevant to the one under discussion.

If a portion of the idle days also occur off-line, such as for bad-order time, the idle-active ratio would be somewhat lower for off-line than for on-line movements, but the difference would be comparatively minor and not of the order of 11 percent versus 58 percent. Therefore, we shall ignore the separation between active days on-line and off-line; further reference to active days will be understood to include both. As was mentioned previously, this change would lower the CPR idle ratio from 58 percent to 44 percent.

Aside from the issue of the theoretical correctness of the CPR method as revised, the execution of the 300 car idle day study contained a number of clerical errors, and at least one systematic error which resulted in duplication of days as both active and idle. In order best to comprehend the problems posed by the CPR revised method and to understand the nature of the error committed, we have shown as Table 1 the itinerary of the car which handled the grain movement in Exhibit A for the entire year 1958. The itinerary has been divided into cycles from unload to unload, with all days identified as idle, active on-line or off-line, according to the rules established by the CPR in the 3700 car active day cycle sample. The grain cycle contained in Exhibit A, appears in Table 1 as the ninth cycle, begun on July 13. When the cycles for this car are totaled for the year, including the incomplete cycles at the beginning and end of the year, we find that,

Analysis of Car-Days -- Car No. XXXXXX -- Year 1958

Date Start of Cycle	Empty Movement From	Empty Movement To	Empty Car-Days Idle	Empty Car-Days Active	Loaded Movement From	Loaded Movement To	Loaded Car-Days Standing	Loaded Car-Days Moving	Off Line Car-Days
?	?	Tadanac	5	1	Beaverdell	Big Beaver(SOO)	4	5	29
2/14	(PM)Windsor	Cooksville	0	2	Cooksville	W. Toronto	9	1	0
2/26	W. Toronto	Parkdale	0	1	Parkdale	W. Toronto	5	1	0
3/5	W. Toronto	Pt. McNicoll	0	1	Pt. McNicoll	Bay Shore	8	8	0
3/22	Bay Shore	Winnipeg	0	10	Winnipeg	Ft. William	20	5	0
4/26	Ft. William	Bindloss	1	5	Bindloss	Vancouver	1	5	0
5/8	Vancouver	Taber	33	10	Taber	Saskatoon	9	3	0
7/2	Sutherland	Marsden	0	2	Marsden	Ft. William	4	5	0
7/13	Ft. William	Tugaske	2	5	Tugaske	Ft. William	14	6	0
8/9	Ft. William	Winnipeg	0	2	Winnipeg	Weyburn	18	4	0
9/2	Weyburn	Redcliff	4	4	Redcliff	Wellcox	5	5	0
9/20	Nanaimo	Wellington	0	1	Wellington	Victoria	3	2	0
9/26	Victoria	Two Hills	20	12	Two Hills	Vancouver	4	7	0
11/8	Vancouver	Exshaw	1	4	Alyth	Kneehill(CNR)	5	1	5
11/24	(CNR)Kneehill	Beiseker	0	2	Beiseker	Winnipeg	10	4	0
12/10	Winnipeg	Bromhead	0	2	Bromhead	Ft. William	7	5	0
12/24	Ft. William	?	5	3					
	Total (=365)		71	67			126	67	34

using the rules established by the CPR, we classified 71 days as idle and 294 days as active. When we look up the annual total for this car in the CPR idle day study, we find that 112 days were considered idle and 253 active, both on-line and off-line. For this one car, the idle day study overstated idle days by 41, with the result that the idle-active ratio was considered to be .44, or 20 percentage points higher than the ratio comparable with the grain cycle study.

The difference arises principally because of an inconsistency between the rules of counting idle days in the two studies, which systematically tends to overstate them in the idle day study, as compared with the grain cycle study. In the latter, all days standing empty at the loading station, at the lakehead, and at Vancouver, were considered active, and were charged directly to grain. In the idle day study, if the car arrived empty at origin or departed empty from destination, up to four days between arrival and departure were considered active, and the excess counted as idle. This reflected the Rail Form A standard allowance for switching in, loading or unloading, and switching out. Thus, any days standing at a grain origin or at the lakehead in excess of four (if preceded or followed by an empty movement) were idle in the idle day study, but active in the grain cycle study.

In the case of the grain movement appearing in Exhibit A, the cycle extended from July 13 through August 9, with July 18 deducted as idle. When we reviewed the car service records for this car, we found that the grain cycle worksheet had omitted some of the entries reported for this movement. As a consequence, one additional idle day at Ignace on July 14 had not been eliminated from the grain cycle. The correct grain cycle was twenty-five, rather than twenty-six active days, with two idle days.

However, when the movements of this grain cycle were classified in the idle day study, the results were quite different. The two idle days at Ignace and Moose Jaw were identified, but of the twelve days standing at Tugaske, eight were also classed as idle. Of the twenty-seven days in the cycle, then, ten were considered idle, and only seventeen as active. Consequently, eight car-days were included both in the active day count and in the idle days to be added thereto. The same inconsistency took place at the export positions, systematically overstating idle days whenever the car departed empty.

Briefly, the CPR developed a count of active car-days chargeable to grain on one definition, and applied a box car idle-active ratio using a different and inconsistent definition. The effect was an automatic overstatement of grain car days and thus of grain costs.

We were able to obtain and review the 1958 car service records of fourteen additional cars of the 300 car idle day study. The results

of tabulating idle and active days in conformity with the grain cycle study have been compared with the results for the same cars in the idle study. Table 2 shows the individual comparisons, and the comparison for all fifteen cars as a group. The average idle days for the group were reduced from 134 to 76, and the implicit idle-active ratio from .58 to .26. If an equal percentage reduction were made in the 300 car CPR study ratio of .44, the new ratio of .20 would result in 1,272 thousand fewer car-days than the CPR assigned to grain, a 24 percent reduction.

Table 2. Idle Day Experience of Fifteen Selected Box Cars, Year 1958

CPR Study Results Compared to Results Consistent with Grain

	Idle Car-Days	
	CPR Study Results	Consistent with Grain
	100	21
	121	59
	80	44
	101	68
	97	28
	107	23
	206	133
	203	168
	117	62
	113	36
	156	95
	106	77
	213	118
	176	133
	112	71
Total Idle Days	2008	1136
Average for 15 Cars	134	76

As a final point on the discussion of the CPR treatment of idle days, we wish to take issue with their theory of assigning the costs of idle days prorata to active days. This has the effect previously noted of longer-than-average movements, such as grain, receiving higher-than-average idle day cost. Much the largest part of the idle time of box cars on the CPR undoubtedly represents empty storage, of which part

is frictional unemployment necessary to a free-flowing supply of cars, part is in response to seasonal fluctuations in the need for cars, and part results from temporary falling off in the general level of traffic. None of these causes of idle car-day cost can be related to the length of time cars are used on particular movements; at best their cost can be considered as required in order to have an adequate supply of cars for loading whenever and wherever loads are offered. Just as many storage days would be needed to cover the number of loads presently offered as would be needed if the average turn around time were either longer or shorter. This is not to say that the size of the car fleet would be unchanged, because fewer would be needed if turnarounds were shorter and vice versa, but the different size fleet would presumably generate the same number of storage days as long as loading requirements remained the same. Therefore, to the extent that idle days represent storage days, it would be more meaningful to relate the cost of idle car-days to the number of car loadings, rather than the number of active days. And since the providing of cars for loads is ordinarily a responsibility of the originating road, the cost of storage days ought to be related to cars originated.

The 300 car idle day study indicated that the average CPR box car was idle 111 days per year. If the reduction in idle days that developed from our review of fifteen cars of the 300 can be applied to the entire study, this figure would be revised to 63 days per year. The average box car ownership of the CPR in 1958 was 49,818, including automobile cars. The system total box car idle days would thus be 3,139 thousand. With 958 thousand box car loadings, both carload and LCL, this works out to 3.3 idle days per load. The total grain cars loaded in 1958, including cars at milling points and allowance for OCS freight, were 168,539, calling for 556 thousand idle days. Since the actual number of idle car-days assigned to grain by the 58 percent ratio was 1,939 thousand, the CPR has overcharged grain traffic with 1,383 thousand days, which would be a 26 percent reduction if removed.

COST OF MONEY

An important element in the cost of grain is an allowance for return on investment in facilities and equipment. This is calculated as 6-1/2 percent of the rail enterprise net book investment after income taxes. Allowing for the revenue needed to pay the taxes, taking into account the 1958 debt-equity ratio, this is equivalent to earning 10.38 percent on investment before taxes for the CPR, and 10.96 percent on the CNR. The data are described as measuring the "cost of money."

The underlying theory in this calculation is first that investment is not to be considered entirely fixed or "sunk" (although this view is applied in the CNR calculation of passenger costs and to part of the existing investment in passenger equipment on the CPR). Particular pieces of property could be obsolete but if they remain in the property base, the railroad would expect to continue earning a return on them. The reason for this is that virtually all property must eventually be replaced. To obtain funds for this replacement, railroad management may be required to go to the money market to float a bond issue or sell stock for some portion of the capital needed. The railroad studies suggest that this capital would be available only at a composite interest and dividend cost of 6-1/2 percent per annum.

It is important to recognize here that the cost of money approach is really looking far into the future. It contemplates the replacement of capital and thus suggests the possibility of a new operating situation. But in calculating expenses, the assumption is made that present operations, present volumes of traffic, and present technology will continue into the future. Thus, there is an inconsistency between the handling of operating expenses and the handling of the cost of money in the railroad studies.

In the CPR study, the allowance of 6-1/2 percent return after taxes, or 10.38 percent before taxes, resulted in charging $21,551 thousand to statutory grain. In 1958, the CPR actually earned 4.17 percent on net investment in rail enterprise before income taxes. If grain were charged with a return based on actual system earnings but otherwise following the CPR method, the study would have shown only $8,658 thousand for this item, a decrease of $12,893 thousand.

The CNR study, incidentally, does not use actual CNR data for estimating the net investment in road property chargeable to grain. Instead, it relies on the CPR net investment function times its own rate of return to construct the cost of money for roadway. Since CNR actually had a net railway operating deficit in 1958, it is clear that charging grain with no more than the average earnings of the CNR system would greatly reduce the costs.

How then does the 10.38 percent factor used by CPR come about? The studies of Witness Smith underlie this figure. They measure cost of money by studying current market prices of securities.

Realism demands that a distinction be made between an indicated cost of money for the CPR and what the cost of money would be if the company actually had the earnings sought. Mr. Smith shows a need for as much as 9-1/2 percent return on the common stockholder's equity of $847 million. This is the principal element in the total cost of money. This means a standard which would produce earnings of up to $80,475 thousand for the common stockholder each year. Based on a total of 14,212 thousand shares of CPR common stock outstanding at the end of 1958, this represents earnings of $5.66 per share. The equity of $847 million used by Mr. Smith represents a value of $59.61 per share. The cost of money concept thus assumes a stock price of $59.61 per share with earnings of up to $5.66 annually.

The target price may be compared with the average price of the common stock as it was actually traded during 1958. Using the working papers of Mr. Smith, the actual price averaged only $26.38 per share in 1958. The proposed yardstick would require an increased price of $33.23 per share, or 126 percent. Since actual common stock earnings in 1958 were $29,834,500, or $2.10 per share, the 9-1/2 percent return of $80 million, or $5.66 per share, would call for an increase in earnings of 170 percent over the actual results in 1958.

If the stockholder who paid an average of $26.38 per share for CPR stock in 1958 knew that a government agency would guarantee him average earnings of $5.66 per share annually, the price of the common stock would probably go far above the indicated book value of $59.61 per share built into the cost calculation. The more certain the earnings, the less the yield needed and the higher the market price of the securities. Stated differently, a shareholder who bought CPR at the book value of $59.61 per share would be happy to hold his shares if the guaranteed earnings were considerably below $5.66 per year.

The principle illustrated above is that a company which has average common stock earnings of 9-1/2 percent on book value will find its new securities can be marketed at a price representing a yield considerably less than 9-1/2 percent. If it can earn 9-1/2 percent, it will be able to maintain credit and attract capital at less than this. A man (or a company) with a good earnings record has little difficulty borrowing from a bank. The less he needs the money, the easier it is to borrow. The high cost of money used is a reflection of past uncertainties which explain why railroad securities, including those of CPR, are often depressed. In setting up a standard of earnings, with the idea that traffic should produce this standard year in and year out, some discounting of the rate seems in order.

Whatever the percentage arrived at, the standard CPR procedure is to apply it to a net book investment. The resulting number of dollars is assumed to be the necessary earnings level. In the case of CPR, the procedure calls for some $149 million in earnings before taxes.

No attempt is made to explain what would be done with such a large sum. It may be compared with actual net rail operating income of $60 million earned by CPR in 1958 before income taxes. The suggested grain yardstick is thus about 2-1/2 times the size of the 1958 actual result.

Suppose a particular company has two steel plants - one old and obsolete and the other new and efficient. At some point, new capital may be needed. Will the management figure out what 10 percent of the net investment in both plants may be? Or will it recognize that it has obtained all the market will bear from the old plant and think only about the need for expanding and developing the new? In the typical industry, the probabilities are that no calculations will be made on the basis of a percentage without regard to the prospective usefulness of the plant. Why should not a similar concept be applied to Canada's railways? Why should Canada include an earnings yardstick in its freight rates which assumes that all of the present plant would be replaced when it is clear that the present plant is more than adequate?

From this overall policy standpoint, a simple rate of return calculation is inadequate - regardless of the percentage used. For many issues, the railroad cost procedure may be necessary. Yet, if we consider the national policy issues, an additional or alternate approach may have more meaning. The real question of revenue need is not determined by a percentage of a base. It is determined by an appraisal of long run capital programs and their effect on total operations. Periodically, railroad management should furnish a long range plan showing capital improvements needed in the various categories of road and equipment property. With this, the resulting benefits or burdens on operating costs should also be supplied. In this way, Canadian authorities will be better able to judge future revenue needs, future capital requirements, and future operating costs. Obviously all three are closely inter-related. Only the procedure for demonstrating the inter-relationship has been lacking.

APPENDIX

Division Indexes of Grade and Curvature

Division	Total Weighted by Mileage	Total Weighted by Freight NTM	Weighted by Mileage Subtotal for: Main Subs.	Branch Sub
DAR	301	295	---	301
Brownville	357	316	313	508
Woodstock	468	359	330	512
QCR	371	356	---	371
Farnham	325	279	315	344
Montreal Terminals	100	100	100	---
Laurentian	345	225	253	518
Smith's Falls	283	194	220	390
Trenton	291	195	244	401
Toronto Terminals	100	100	100	---
London	261	217	210	314
Bruce	309	212	194	357
Sudbury	292	239	252	412
Schreiber	295	296	294	300
Ft. William Terminals	100	100	100	---
Kenora	186	185	185	192
Winnipeg Terminals	100	100	100	100
Portage	193	185	181	196
Brandon	236	226	251	224
Regina	195	185	182	201
Moose Jaw	227	178	172	233
Saskatoon	196	174	171	212
Medicine Hat	211	192	199	217
Lethbridge	251	249	260	247
Calgary	285	276	284	288
Edmonton	220	162	221	220
Revelstoke	292	366	367	212
Vancouver	239	234	237	271
Kootenay	428	312	352	654
Kettle Valley	361	333	389	283
E and N	421	308	---	421

Note: Indexes are reciprocals of tonnage ratings for standard diesel units, related to the tonnage rating over straight, level track at 100.

--- Adjournment.